

THIS REPORT HAS BEEN DELIMITED  
AND CLEARED FOR PUBLIC RELEASE  
UNDER DOD DIRECTIVE 5200.20 AND  
NO RESTRICTIONS ARE IMPOSED UPON  
ITS USE AND DISCLOSURE.

DISTRIBUTION STATEMENT A

APPROVED FOR PUBLIC RELEASE,  
DISTRIBUTION UNLIMITED.

# med Services Technical Information Agency

Because of our limited supply, you are requested to return this copy WHEN IT HAS SERVED YOUR PURPOSE so that it may be made available to other requesters. Your cooperation will be appreciated.

AD

41734

NOTICE: WHEN GOVERNMENT OR OTHER DRAWINGS, SPECIFICATIONS OR OTHER DATA ARE USED FOR ANY PURPOSE OTHER THAN IN CONNECTION WITH A DEFINITELY RELATED GOVERNMENT PROCUREMENT OPERATION, THE U. S. GOVERNMENT THEREBY INCURS NO RESPONSIBILITY, NOR ANY OBLIGATION WHATSOEVER; AND THE FACT THAT THE GOVERNMENT MAY HAVE FORMULATED, FURNISHED, OR IN ANY WAY SUPPLIED THE SAID DRAWINGS, SPECIFICATIONS, OR OTHER DATA IS NOT TO BE REGARDED BY ANY PERSON OR CORPORATION, OR CONVEYING ANY RIGHTS OR PERMISSION TO MANUFACTURE, REPRODUCE, OR SELL ANY PATENTED INVENTION THAT MAY IN ANY WAY BE RELATED THERETO.

Reproduced by  
DOCUMENT SERVICE CENTER  
KNOTT BUILDING, DAYTON, 2, OHIO

UNCLASSIFIED



AD NO. 471127

ASTIA

FILE COPY

# THE MUNICIPAL UNIVERSITY OF WICHITA

PERFORMANCE TEST OF A SIDE-INLET,  
STREAM-TO-AIR JET PUMP WITH AN INBOARD  
NOZZLE AND A TAPERED MIXING TUBE

by A. M. Heinrich

Engineering Report No. 133

for the Office of Naval Research  
Contract N-onr 201(01)



May 1954  
University of Wichita  
School of Engineering  
Wichita, Kansas

PERFORMANCE TEST OF A SIDE-INLET,  
STEAM-TO-AIR JET PUMP WITH AN INBOARD  
NOZZLE AND A TAPERED MIXING TUBE

by A. M. Heinrich

Engineering Report No. 138

for the Office of Naval Research  
Contract N-onr 201(01)

May 1954  
University of Wichita  
School of Engineering  
Wichita, Kansas

TABLE OF CONTENTS

	1
LIST OF FIGURES	11
SUMMARY	1
INTRODUCTION	2
SYMBOLS AND SUBSCRIPTS	2
TESTS	3
APPARATUS	3
PERFORMANCE ANALYSIS	4
RESULTS AND DISCUSSION	5
CONCLUSIONS	6
REFERENCES	6
APPENDIX - Test Log of SISA-3 Jet Pump	7
TABLE - SISA-3 Jet-Pump Performance	10
FIGURES	11

LIST OF FIGURES

Figure	Page
1.- Planform outline; side-inlet, steam-to-air jet pump.	11
2.- Cross section of SISA-3 jet-pump at diffuser entrance.	12
3.- Cross section of SISA-3 jet-pump at nozzle exit.	13
4.- Arrangement of the mixing and blowing tubes.	14
5.- Arrangement of mixing-tube pressure taps and throat adjustment bolts.	14
6.- Suction slot with static pressure taps.	15
7.- View of the jet pump looking through the suction slot and duct into the cascaded mixing-tube throat.	15
8.- Instrumentation schematic.	16
9.- Variation of pressure ratio with mass ratio.	17
10.- Variation of efficiency with mass ratio.	18
11.- Variation of efficiency with pressure ratio.	19
12.- Distribution of available energy efficiency.	20
13.- Variation of suction-duct total-pressure loss with flow quantity.	22
14.- Influence of cascades, jet total pressure, and pressure ratio on suction-slot quantity distribution.	23
15.- Suction duct flow pattern.	30
16.- Mixing-tube entrance throat widths.	31
17.- Influence of cascades, jet total pressure, and pressure ratio on throat static pressure distribution.	32
18.- Influence of cascades, jet total pressure, and pressure ratio on mixing-tube static-pressure distribution.	38
19.- Influence of jet total pressure and pressure ratio on mixing-tube total-pressure distribution.	45
20.- Influence of jet total pressure and pressure ratio on temperature distribution.	61

## SUMMARY

A series of tests were conducted to determine the performance, the pressure and temperature distributions, and the nature of the flow in a side-inlet jet-pump with an inboard nozzle. This series of tests were performed on a pump having a conical mixing tube, a cascaded side-entrance throat, a suction duct, and a suction slot of constant width.

The effects of varying the primary jet pressure, the pump pressure ratio, and the cascades were determined. Pump pressure ratio was varied both with and without control of the suction-slot flow distribution. Flow direction in the suction duct between the slot and the throat was studied with the aid of wool tufts.

Performance curves are presented together with curves showing mixing-tube, cross-sectional distributions of temperature and total pressure taken at several survey stations. This report is the second in a series on side-inlet jet pumps with different taper ratio mixing tubes.

## INTRODUCTION

The side-inlet steam-to-air jet pump provides a simply constructed and compact air pump to fulfill the requirements of a high-speed aircraft system of wing circulation control. As a continuance of the experimental analysis of side-inlet steam-to-air jet pumps, a conical mixing-tube pump was tested.

The purpose of this report was to organize the data and present the test results in a manner usable for a comparative evaluation with previous jet pump tests by the University of Wichita. The design, construction and tests of the jet pump were performed by the University of Wichita, School of Engineering under the authority of Contract N-onr 201(01) from the Air Branch of the Office of Naval Research.

## SYMBOLS

D	diameter of mixing tube or throttling orifices, inches
$\rho$	density, slugs/ft <sup>3</sup>
n	enthalpy, BTU/lb
t	temperature, °F
P <sub>t</sub>	total pressure, lb/ft <sup>2</sup>
p	static pressure, lb/ft <sup>2</sup>
P	power, ft-lb/sec
J	mechanical equivalent of heat, 778 ft-lb/BTU
V	velocity, ft/sec
v	local velocity, ft/sec
q	volumetric flow rate, ft <sup>3</sup> /sec
w	weight flow rate, lb/sec
$\alpha$	pressure ratio = $p_{t3}/p_{t0}$
$\mu$	mass ratio = $w_s/w_j$
$\eta$	efficiency = $P_{eff}/P_{in}$

## Subscripts

0	free-stream or ambient conditions
1	suction-slot conditions
2	mixing-tube-entrance throat conditions
3	mixing-tube exit conditions
AE	available energy

3

j primary or jet flow  
s secondary flow  
m mixture of primary and secondary flow  
x axial position from the inboard end of mixing tube  
in input  
eff effective

### TESTS

The testing and data recording were in accordance with the pre-test report (Reference 1). Throat adjustments were made to give maximum secondary-air mass flow with a desirable suction-slot flow-quantity distribution. All tests were run with a constant suction-slot width.

The following measurements were taken:

- 1.- Suction-slot area.
- 2.- Suction-slot static pressure distribution.
- 3.- Suction-slot air temperature.
- 4.- Mixing-tube-entrance throat area.
- 5.- Mixing-tube-entrance throat static pressure distribution.
- 6.- Mixing-tube-entrance throat air temperature.
- 7.- Mixing-tube static-pressure distribution.
- 8.- Mixing-tube cross-sectional, total-pressure distribution.
- 9.- Mixing-tube cross-sectional, temperature distribution.
- 10.- Steam temperature.
- 11.- Steam total pressure.
- 12.- Barometric pressure.
- 13.- Mixing-tube exit:  
Variation of the jet-pump throttling by successive steps from an open exit to a condition of slight reverse flow in the suction slot.

### APPARATUS

Figures 1 through 5 show the layout and the side-inlet jet pump construction. The inlet duct, cascades, mixing tube, and blowing tube were fabricated from sheet metal. The suction slot and supporting framework were made of wood and angle iron. Entrance points for the primary and secondary streams and their flow through the jet pump are shown schematically in figures 1, 2, and 3.



The model variables consisted of the mixing-tube entrance throat width and blowing-tube exit throttling. Variation of the primary steam flow total pressure and temperature was obtained through control of the steam generator-superheater system described in reference 2. Manometers and probes used in the tests are shown in figure 7 and also in reference 2.

#### PERFORMANCE ANALYSIS

The jet-pump performance parameters were detailed in the pre-test report (Ref. 1) and in Reference 2. An attempt was made to determine the influence of specific impulse on performance. The results of this attempt were, however, considered invalid since irregular mixing tube static pressure distribution occurred. The irregularities were presumably a result of off-design expansion characteristics of the nozzles used to obtain the variation in specific impulse. Total pressure losses in the suction duct were determined from average velocities and pressures found by integrating the flow quantity distribution curves.

The approximate total-pressure losses in the suction duct were determined from the relation

$$\begin{aligned} p_t &= p_{t1} - p_{t2} = p_{t0} - \left[ (p_{t0} + p_2) + \frac{1}{2} \rho_2 v_2^2 \right] \\ &= -p_2 - \frac{1}{2} \rho_2 v_2^2. \end{aligned}$$

The effective power output, the power input, and the efficiency were determined from the following relations from reference 1.

$$P_{eff} = q_s (p_{t3} - p_{t1}) + q_j (p_{t3} - p_{t0})$$

$$P_{in} = w_j \Delta h_j$$

$$\eta = \frac{P_{eff}}{P_{in}}$$

The mass ratio was expressed by the secondary to primary weight flow ratio,

$$\mu = w_s / w_j.$$

Jet-pump pressure ratio was defined as the ratio of the mixed-flow total pressure, at the final plane, to the ambient total pressure

$$\alpha = p_{t3} / p_{t0}.$$

The available energy efficiency at any point in the mixing tube was the ratio of the local available energy of the mixture to the available energy of the primary flow at the nozzle and was expressed by the following relation of the kinetic and pressure energies.

$$\eta_{AEx} = \frac{\frac{1}{2} \rho_{mx} v_{mx}^2 + p_{mx}}{\frac{1}{2} \rho_j v_j^2}$$



## RESULTS AND DISCUSSION

Figures 9 through 11 show a performance summary of the side-inlet stream-to-air jet pump having a tapered mixing tube. For the tests with uncontrolled suction-slot quantity distribution the pressure ratio varied linearly as a function of the higher mass ratios. This linearity, however, existed only to the point of incipient reverse flow in the suction duct. As the reverse flow spread through the suction duct and slot the performance curve departed appreciably from the linear relationship. The tests with the suction-slot flow quantity controlled for distribution show a lower maximum pressure ratio, a more rapid deterioration of performance after suction-slot reverse flow appeared, but exhibited a better performance in the region of high mass ratios and low pressure ratios.

Figure 12 shows the distribution of the available energy. Usable energy was available through the mixing tube almost to the diffuser entrance. The location at which the available energy was reduced to less than one percent of the initial value was the same for all the pressure ratios and mass ratios tested.

The variation of suction-duct total-pressure loss with flow quantity is shown in figure 13. The most losses were experienced for the highest pressure ratios. A linear increase of losses resulted from an increase in secondary flow where the pressure ratio and throat width were constant.

Complete cascading of the entrance throat gave a higher mass ratio and better distribution of suction-slot flow than any partial cascade arrangement tested (shown by figure 14). Tuft pictures of the flow within the suction duct (fig. 15) showed the air flow turning upstream of the cascade location in the suction duct. The airflow divided at the juncture of cascades and unobstructed throat.

Figure 16 gives the throat widths required for the slot quantity distribution. Figure 17 shows the effect of cascade arrangement, jet total-pressure variation, and pressure ratio variation on the distribution of static pressure in the mixing - tube throat. Runs 11 through 22 show only the effect of pressure ratio while runs 23 through 29 show combined effects of pressure ratio and slot width.

Variation of the jet total pressure did not appreciably change suction-slot quantity distribution. Throttling the pump sufficiently to cause suction-slot reverse flow progressively decreased the slot flow quantity with the greatest effect occurring in the outboard area. Increase of pressure ratio while maintaining nearly uniform suction-slot quantity distribution resulted in a continual decrease of secondary air flow.

The mixing-tube static-pressure distributions for the various cascade arrangements, jet total pressures, and pressure ratios are shown in figure 18. Figures 19 and 20 show cross-sectional survey data of mixing-tube total pressure and temperature at several stations. Surveys in the inboard portion of the mixing tube showed a low energy secondary flow and a high energy primary flow in their adjacent relative positions. In the portion of the mixing tube approaching the diffuser the mixing-tube flow appeared mixed as indicated by the total pressure profiles, while at the diffuser exit the flow was almost completely mixed. The temperature surveys in the mixing tube supplemented the total-pressure surveys and demonstrated by the low or high temperatures the areas of unmixed secondary and primary flow. Average integrated values of the horizontal and vertical total-pressure profiles combined with the local static pressures were used to approximate the local available energy of the mixing tube flow.

The performance analysis of the SISA-3 steam-to-air jet pump with the side inlet and tapered mixing tube was made to comparatively show the effect of mixing-tube shape. Also, this analysis shows the relative merits of secondary airflow guidance and distribution methods as compared to the cylindrical mixing-tube pump of reference 2.

#### CONCLUSIONS

The experimental analysis of a side-inlet, steam-to-air jet pump with an inboard nozzle and a conical mixing tube has shown this arrangement to have reasonably low losses for desirable suction slot quantity distribution properties. Suction-slot flow-quantity distribution was easily obtained as a result of the available energy distribution through the mixing tube. Regulation of the available energy distribution was obtained through the diffuser action of the conical mixing tube.

A comparative evaluation of the presented data with the data for the cylindrical mixing tube of reference 2 should provide sufficient information to formulate a design procedure for the side-inlet steam driven jet pump. Further tests should be conducted to produce any specific design to reduce the losses to a minimum.

#### REFERENCES

- 1.- Heinrich, A.M.: Pre-test Report on the Performance Study of a Side-Inlet Jet-Pump with an Inboard Nozzle. University of Wichita Engineering Study No. 117, October 1953.
- 2.- Heinrich, A.M.: Performance Test of a Side-Inlet, Steam-to-Air Jet Pump with an Inboard Nozzle. University of Wichita Engineering Report No. 131, February 1954.

## APPENDIX

TEST LOG OF SISA-3 JET PUMP

Runs SISA-3-1 through SISA-3-29

# TEST LOG, SISA-3 JET PUMP

<u>Run No.</u>	<u>Configuration</u>	<u>Remarks</u>
1 thru 5	<p>Constant slot width with throat adjusted for slot quantity distribution in run no. 1 only.</p> <p>Cascade configuration as follows:</p> <p>Run 1 - all cascades.</p> <p>Run 2 - 36 inches of cascades inboard.</p> <p>Run 3 - 24 inches of cascades inboard.</p> <p>Run 4 - 12 inches of cascades inboard.</p> <p>Run 5 - without cascades.</p>	<p>These five runs were made to determine the influence of the mixing-tube cascades on performance and on suction-slot quantity distribution.</p> <p>Test results showed the configuration with all cascades to be the most desirable.</p>
6 thru 10	<p>Constant slot width with the throat adjusted to give maximum secondary flow and desired suction-slot distribution. The jet total pressure was varied as follows:</p> <p>Run 6 - ptj = 344.2 psia</p> <p>Run 7 - ptj = 314.2 psia</p> <p>Run 8 - ptj = 287.2 psia</p> <p>Run 9 - ptj = 262.2 psia</p> <p>Run 10 - ptj = 237.2 psia</p>	<p>These five runs were made to determine the influence of the primary-jet total pressure on the performance.</p> <p>The static-pressure distribution of the throat and mixing tube were measured.</p>
11 thru 20	<p>Constant slot width with the throat adjusted for best secondary-flow quantity distribution in the open-exit configuration. This throat was maintained for runs 11 thru 20.</p> <p>Throttled as follows:</p> <p>Run 11 - <math>D_4/D_3 = 1.0</math></p> <p>Run 12 - " = 0.942</p> <p>Run 13 - " = 0.906</p> <p>Run 14 - " = 0.857</p> <p>Run 15 - " = 0.823</p> <p>Run 16 - " = 0.792</p> <p>Run 17 - " = 0.765</p> <p>Run 18 - " = 0.723</p> <p>Run 19 - " = 0.673</p> <p>Run 20 - " = 0.622</p>	<p>These ten runs were made to determine the effects of increased pressure ratio on mass ratio, secondary-flow quantity distribution and throat and mixing tube static-pressure distributions.</p>

<u>Run No.</u>	<u>Configuration</u>	<u>Remarks</u>
21 and 22	<p>Constant slot width with the throat adjusted for best secondary flow quantity distribution in unthrottled configuration.</p> <p>Throttled as follows:</p> <p>Run 21 - <math>D_4/D_3 = 1.0</math>  Run 22 - " = 0.765</p>	<p>These two runs were made to determine the nature of the mixing-tube flow at two values of pressure ratio. The secondary flow was not controlled for quantity distribution.</p>
23 thru 27	<p>Constant slot width with the throat adjusted to give desired secondary flow quantity distribution for each run.</p> <p>Throttled as follows:</p> <p>Run 23 - <math>D_4/D_3 = 1.0</math>  Run 24 - " = 0.906  Run 25 - " = 0.323  Run 26 - " = 0.765  Run 27 - " = 0.723</p>	<p>These five runs were made to determine the performance and the effects of pressure ratio on mass ratio with the secondary flow evenly distributed along the suction slot.</p>
28 and 29	<p>Constant slot width with the throat adjusted to give desired secondary flow quantity distribution for each run.</p> <p>Throttled as follows:</p> <p>Run 28 - <math>D_4/D_3 = 0.792</math>  Run 29 - " = 0.857</p>	<p>These two runs were made to supplement the data of runs 23 to 27, and to determine the nature of the mixing-tube flow at two values of pressure ratio.</p>

TABLE - SISA-3 Jet Pump Performance

Run No.	ptj (psia)	tj (°F)	ws (lb/sec)	wj (lb/sec)	$\mu = \frac{ws}{wj}$	$\alpha = \frac{pt3}{pt0}$	$\eta$
1	304.3	660	2.56	0.232	11.03	1.013	2.405
2	304.3	660	2.45	0.232	10.56	1.013	2.48
3	304.3	660	2.44	0.232	10.52	1.012	2.46
4	304.3	660	2.31	0.232	9.96	1.011	2.40
5	304.3	660	2.23	0.232	9.61	1.01	2.31
6	344.2	658	2.68	0.26	10.3	1.013	2.295
7	314.2	662	2.61	0.239	10.9	1.017	3.24
8	287.2	645	2.54	0.218	11.65	1.021	3.97
9	262.2	660	2.415	0.201	12.0	1.025	4.64
10	237.2	650	2.33	0.182	12.8	1.03	5.20
11	298.08	653	2.505	0.224	11.18	1.034	5.63
12	298.07	653	2.403	0.224	10.72	1.039	6.20
13	298.07	651	2.320	0.2236	10.38	1.043	6.49
14	298.07	652	2.19	0.2238	9.79	1.05	7.16
15	297.07	653	2.07	0.223	9.28	1.053	7.39
16	297.07	653	1.98	0.223	8.88	1.012	4.28
17	297.06	655	1.855	0.2233	8.81	1.04	6.15
18	297.06	654	1.765	0.2231	7.91	1.01	2.495
19	299.10	658	1.538	0.225	6.83	1.022	4.52
20	299.10	660	1.362	0.2255	6.04	1.03	5.40
21	298	652	2.415	0.224	10.8	1.014	1.20
22	297.3	652	1.84	0.2235	8.23	1.0265	3.67
23	296.65	657	2.58	0.2330	11.55	1.03	5.38
24	296.65	654	2.48	0.2225	11.13	1.03	
25	296.65	653	2.085	0.2224	9.37	1.02	
26	297.15	653	1.071	0.2224	4.81	1.014	
27	296.65	650	0.686	0.221	3.08	1.014	
28	296.95	657	1.562	0.223	7.00	1.0265	
29	297.02	653	2.235	0.2235	10.00	1.03	



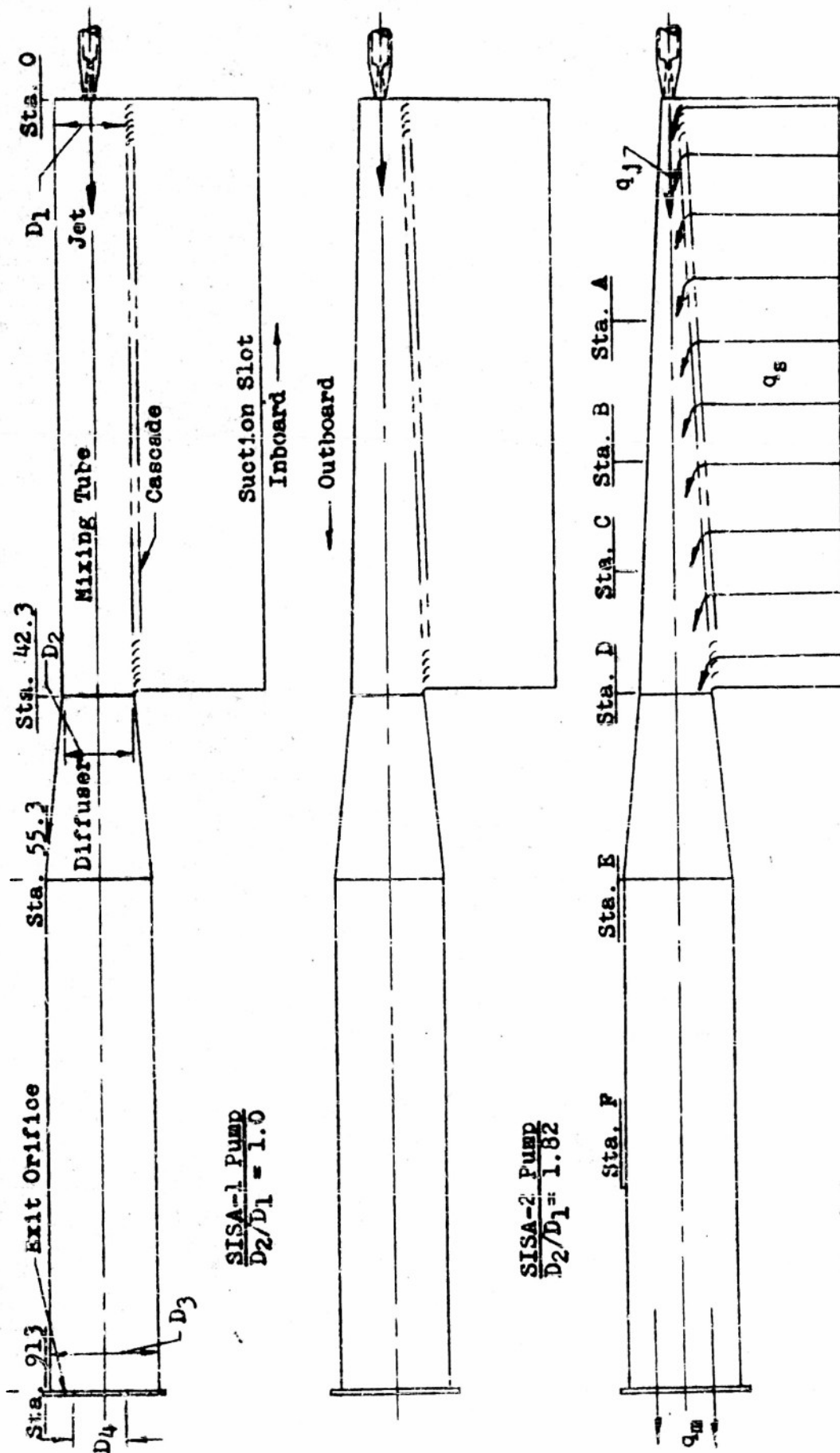


Figure 1.- Planform outline; side-inlet, steam-to-air jet pump.

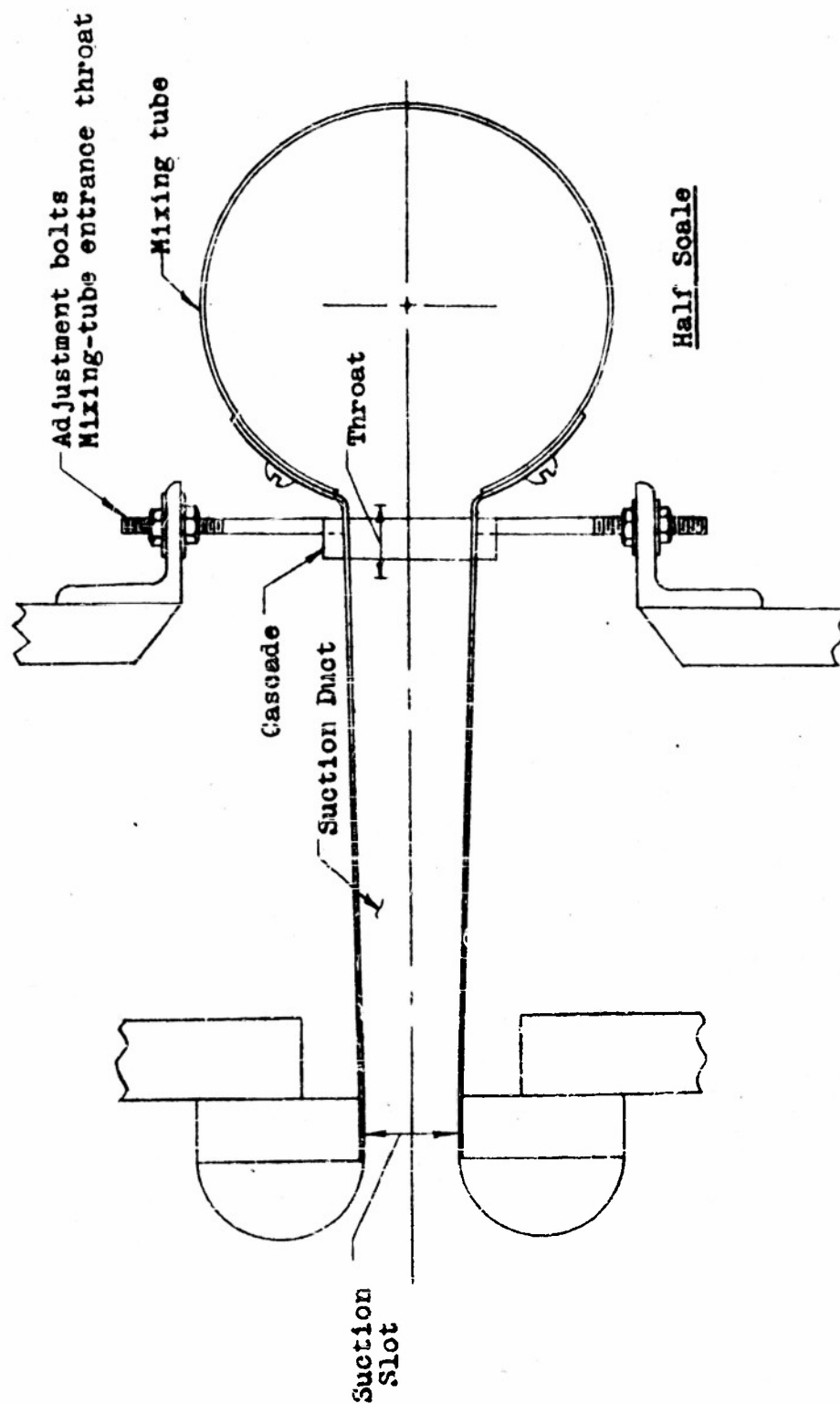


Figure 2.- Cross section of SISA-3 jet-pump at diffuser entrance.



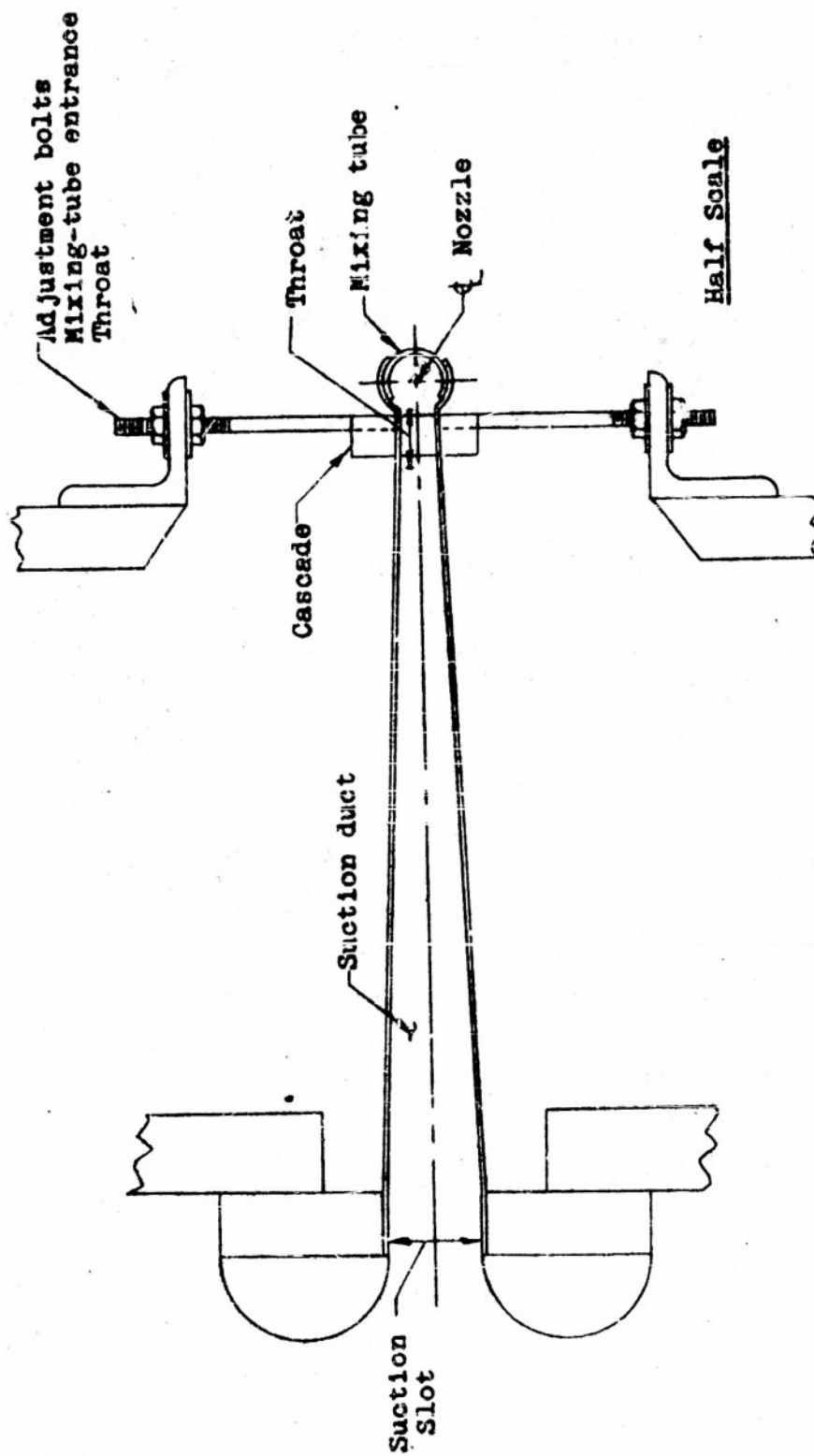


Figure 3.- Cross-section of SISA-3 jet-pump at nozzle exit.

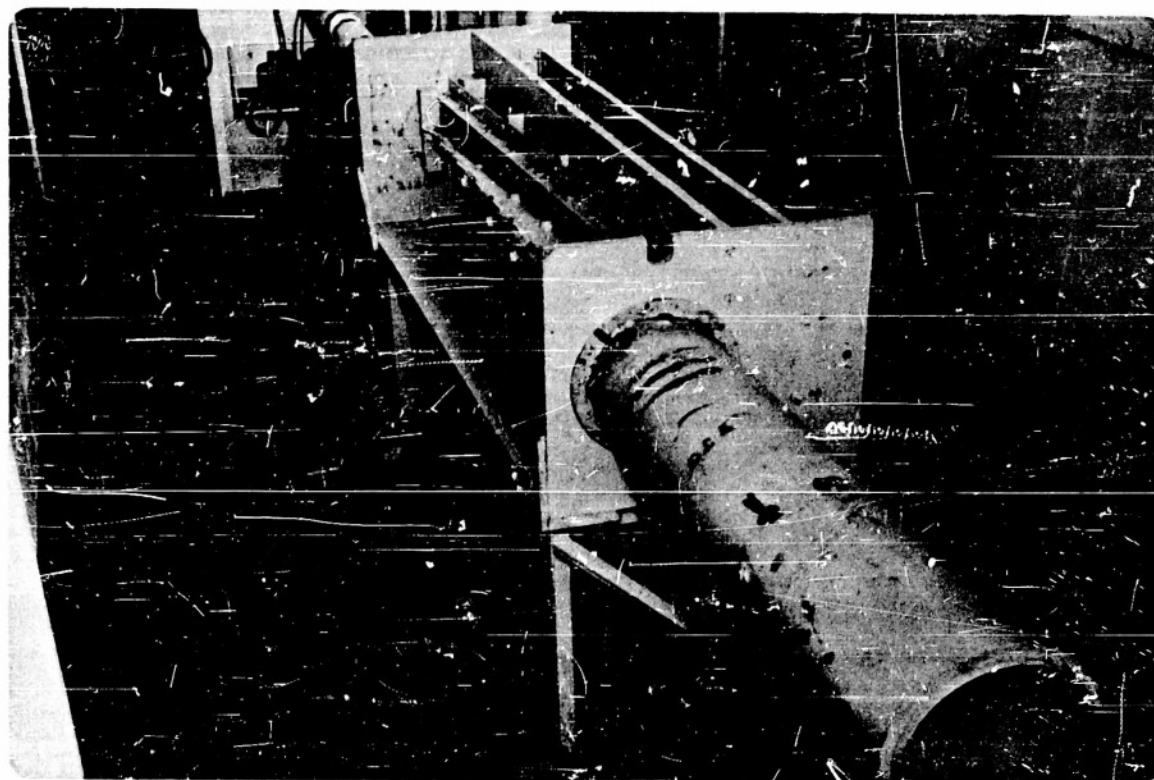


Figure 4.- Arrangement of the mixing and blowing tubes

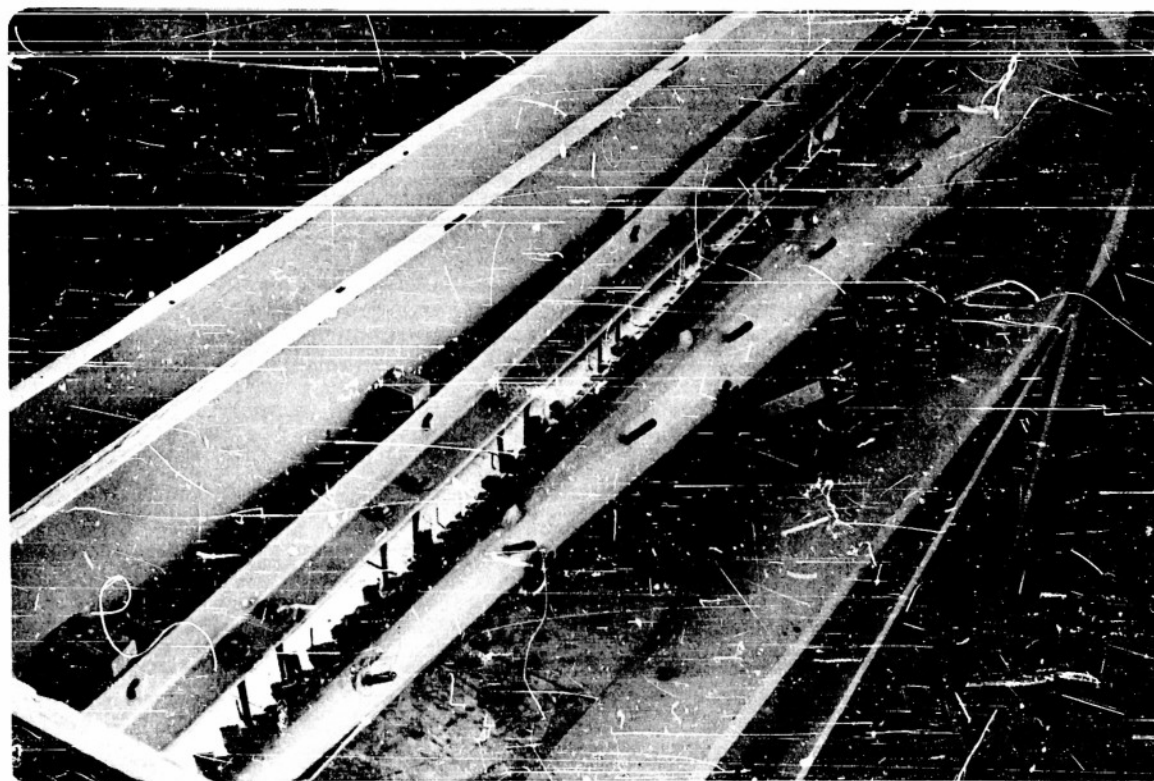


Figure 5.- Arrangement of mixing-tube pressure taps and throat adjustment bolts

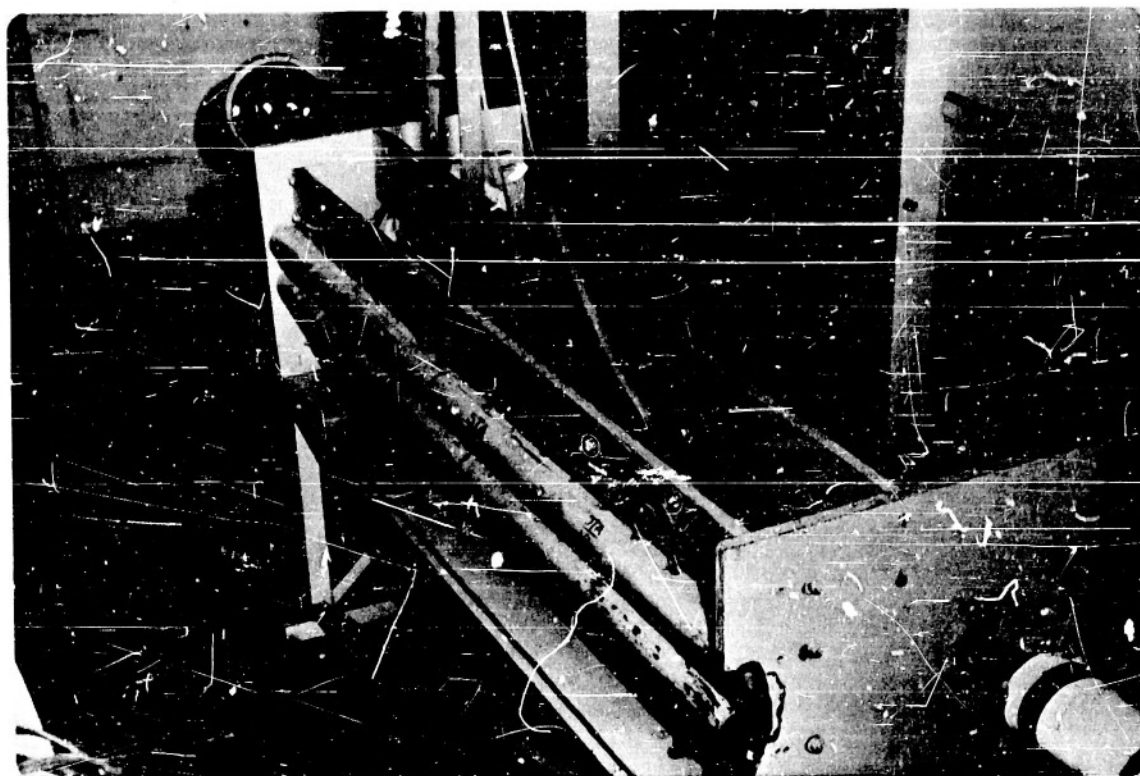


Figure 6.- Suction slot with static pressure taps.

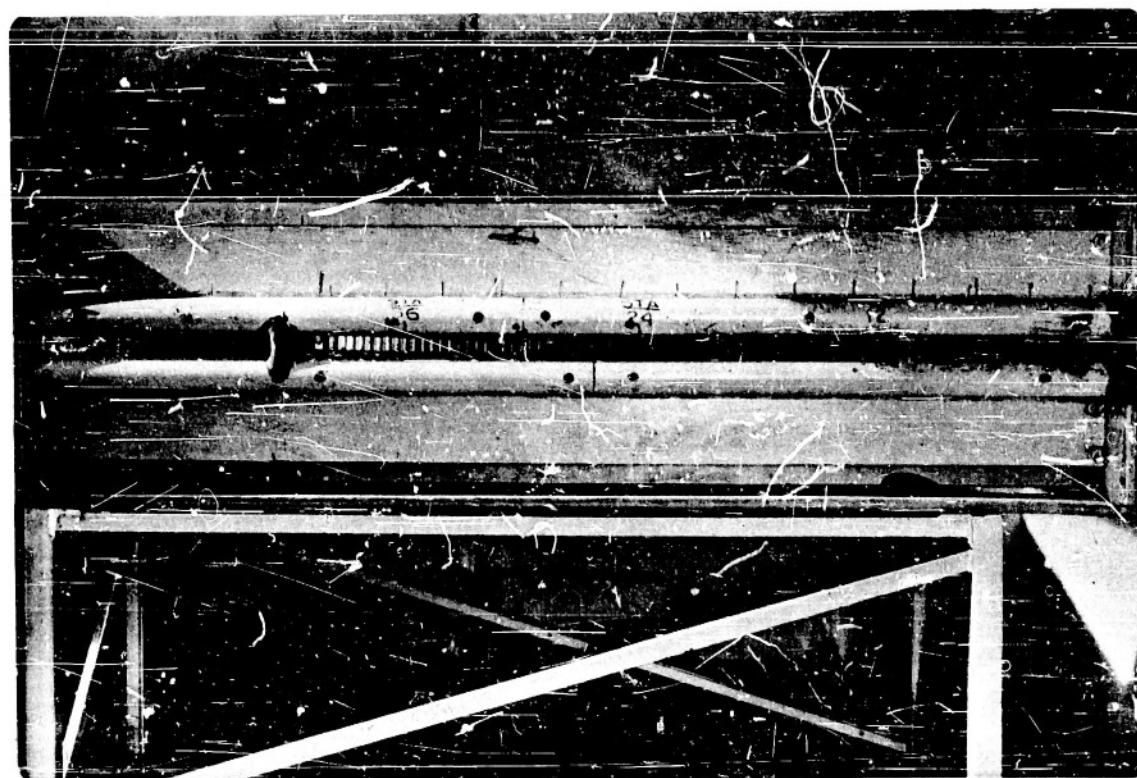


Figure 7.- View of the jet pump looking through the suction slot and duct into the cascaded mixing-tube throat.

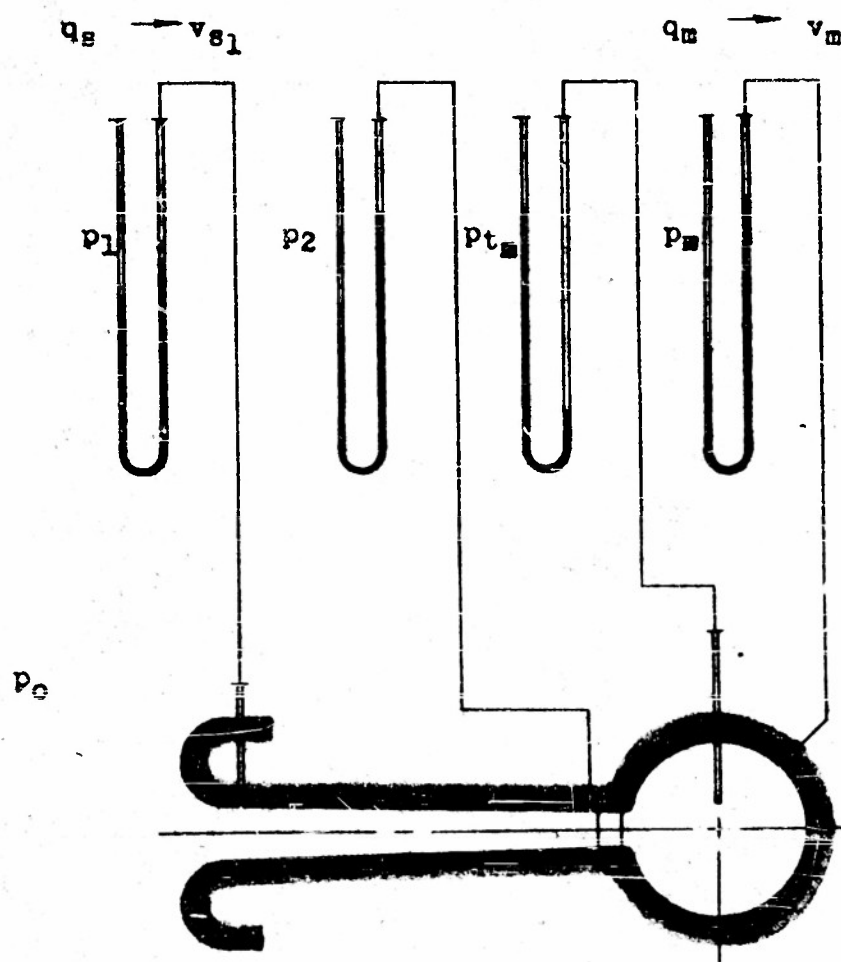


Figure 8.- Instrumentation schematic.



UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

# VARIATION OF PRESSURE RATIO WITH MASS RATIO SISA-3 JET ENGINE

○ WITHOUT DISTURBANCE OF BURTON SLOT FLOW -  $P_2$  CONSTANT  
□ WITH DISTURBANCE OF BURTON SLOT FLOW -  $P_2$  CONSTANT  
◇ WITH DISTURBANCE OF BURTON SLOT FLOW -  $P_2$  VARIABLE

○ RUNS SISA-3-1 THRU -20

□ RUNS SISA-3-23 THRU -29

◇ RUNS SISA-3-6 THRU -10

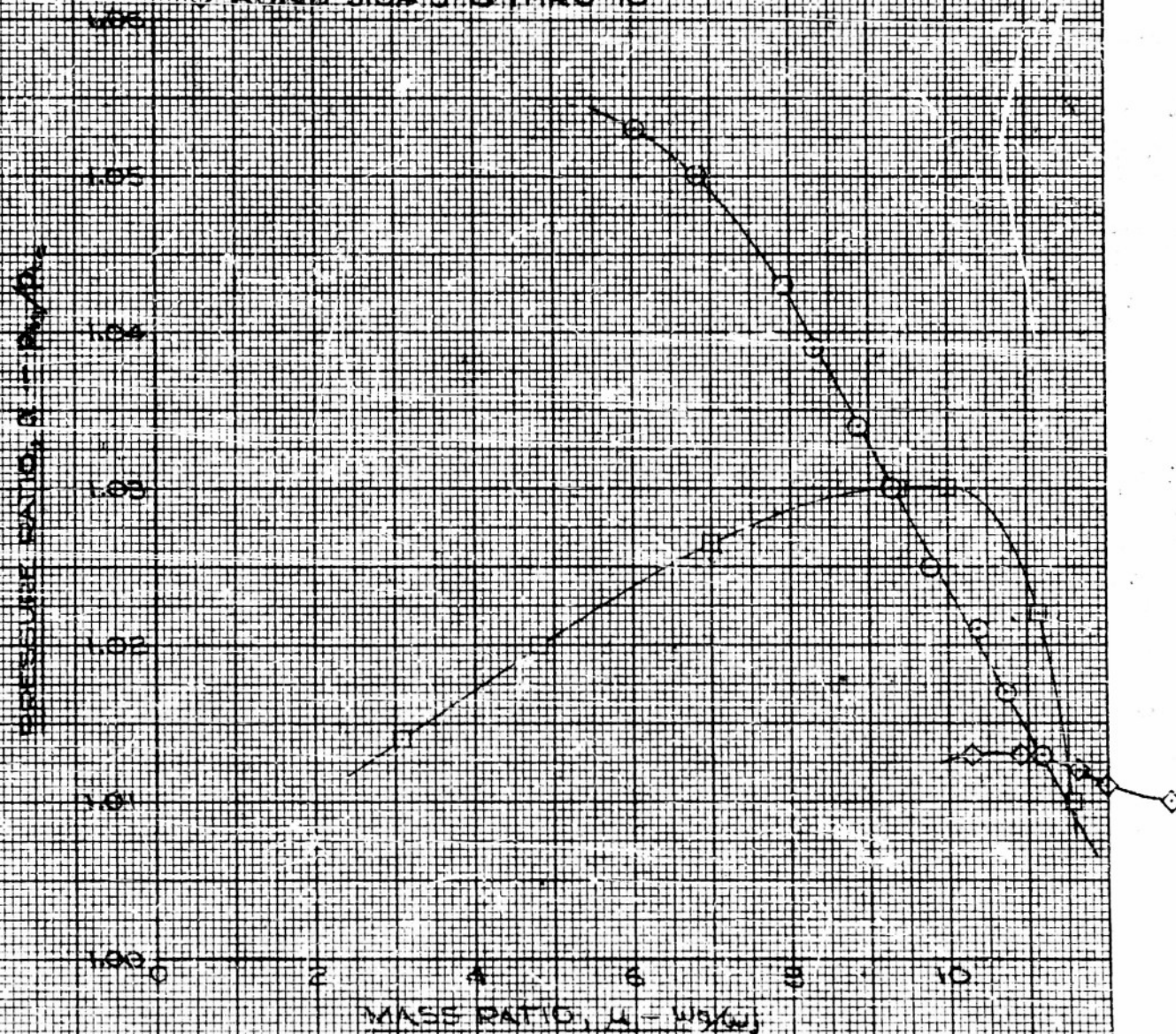


FIGURE 3

UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

# VARIAION OF EFFICIENCY WITH MASS RATIO

SERIAL-JET PUMP

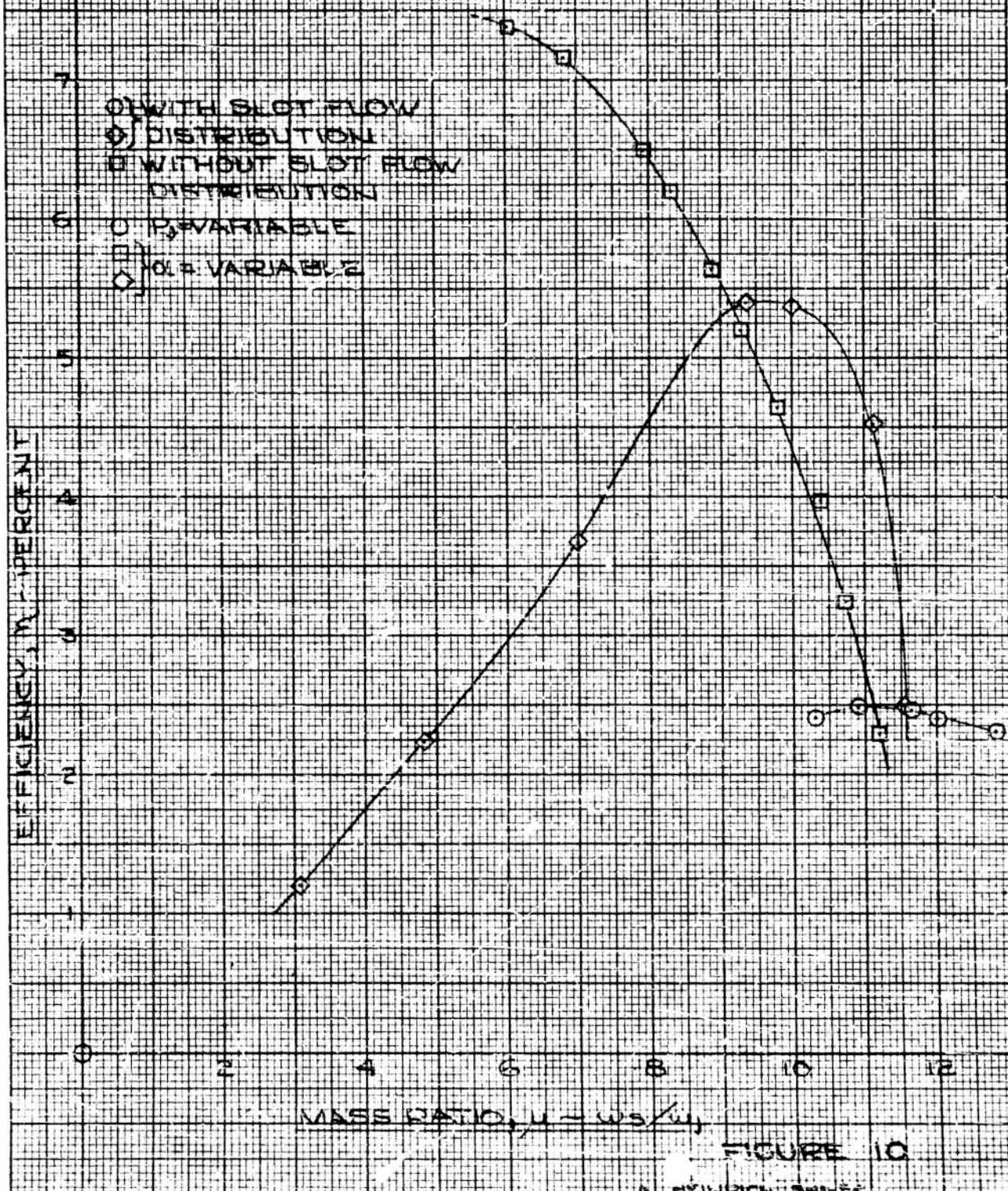


FIGURE 10

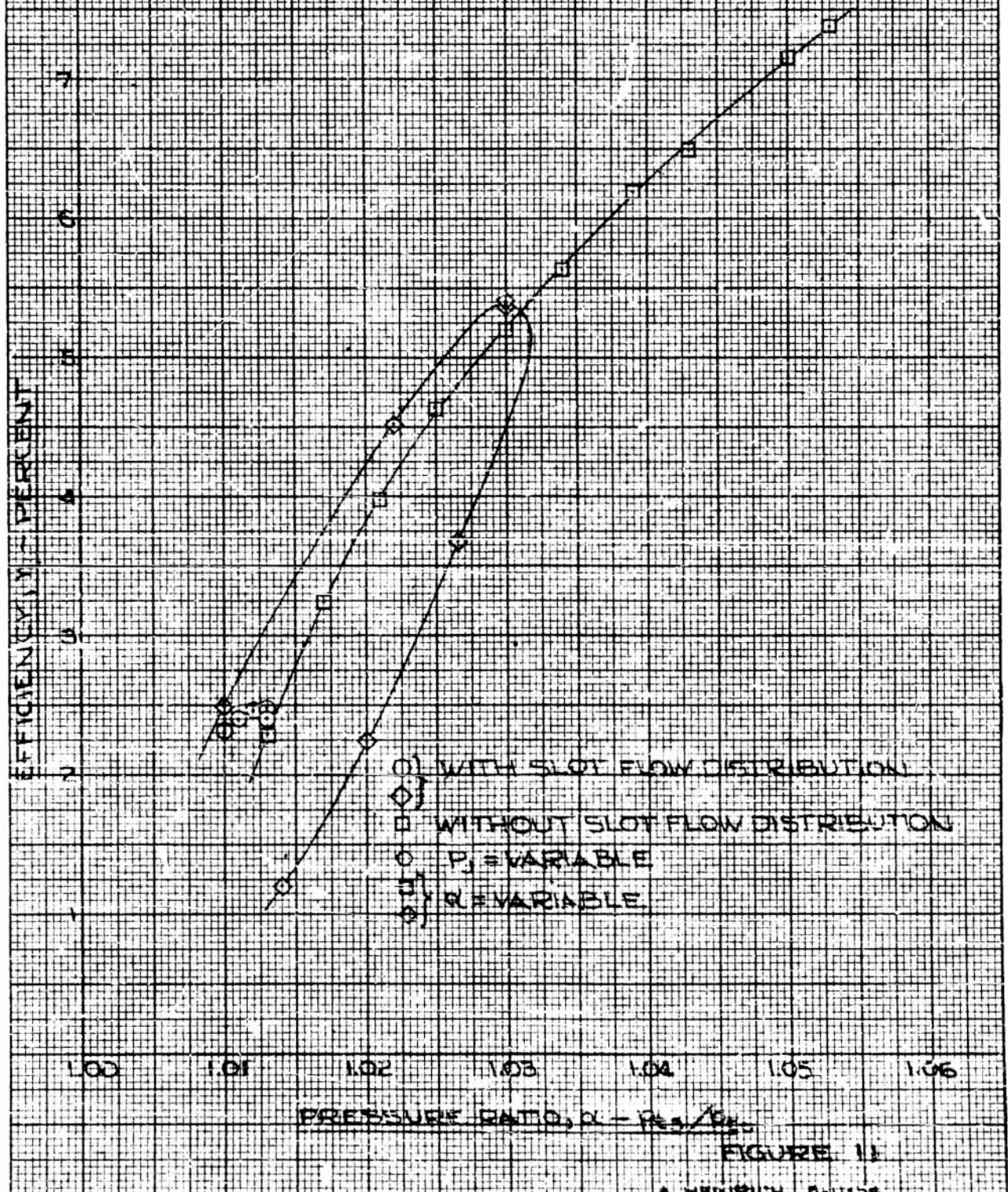
K-E KENNEL & ESSER CO.  
10 X 10 TO THE 1/2 INCH 328-11



UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

# VARIAION OF EFFICIENCY WITH PRESSURE RATIO

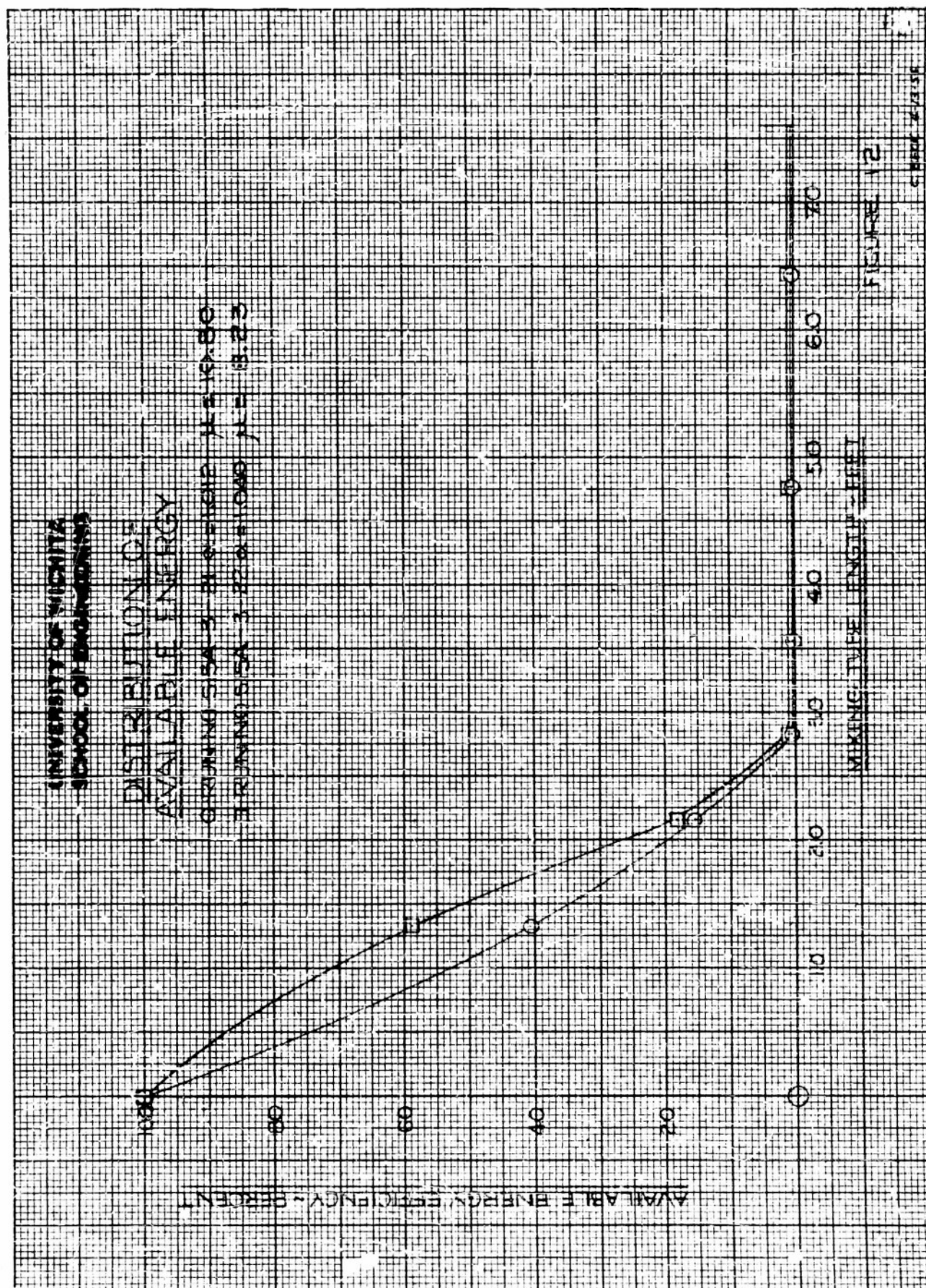
SIGAS JET PUMP



K. M. KESLER &amp; EMMER CO.

INDUSTRIAL  
328-11

10 X 10 TO THE 1/2 INCH





K.E. KELLEY & EBER CO.  
10 X 10 TO THE 1/2 INCH 388-11

UNIVERSITY OF CHINA  
SCHOOL OF ENGINEERING

DISTRIBUTION OF  
AVAILABLE ENERGY

ON THE 0.0150 0.0150 0.0150 0.0150  
ON THE 0.0150 0.0150 0.0150 0.0150

AVAILABLE ENERGY REFLECTED PERCENT

DIFFUSE REFLECTANCE

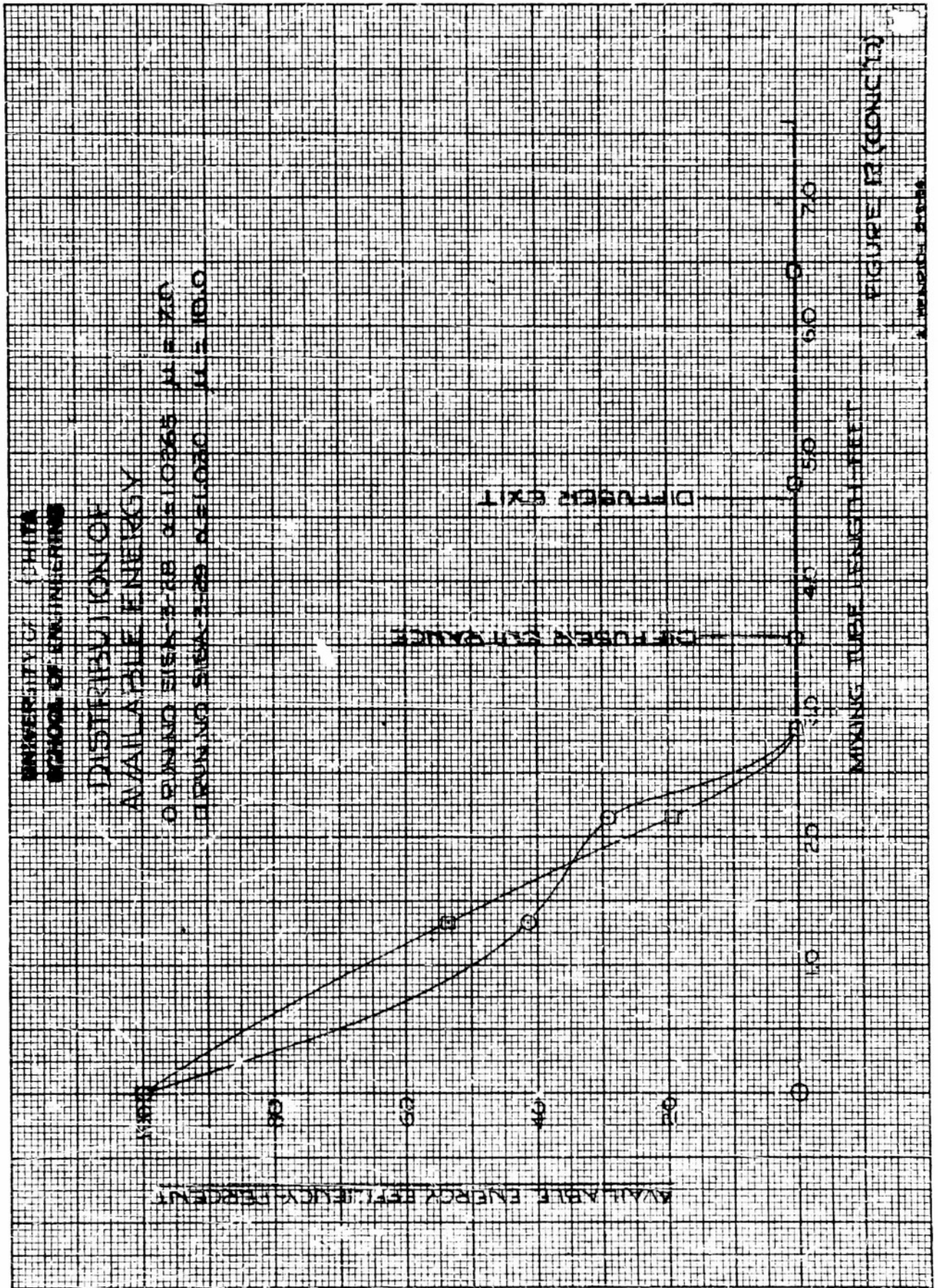
DIFFUSE EXIT

MIXING TUBE LENGTH FEET

FIGURE 12 (CONC'D)

100 80 60 40 20 0

0 10 20 30 40 50 60 70







UNIVERSITY OF WISCONSIN  
SCHOOL OF ENGINEERING

EFFECT OF CASCADES  
ON SECTION 5 OF  
QUANTITY DISTRIBUTION

$P_0 = 304.1 \text{ PSIA}$

VELOCITY x SLOT WIDTH - FT/SEC

○ RUN NO 515A 3-1 WITH CASCADES  $M = 11.03$   
 □ RUN NO 515A 3-2 36 INCHES OF CASCADES INBD  $M = 10.56$   
 ◇ RUN NO 515A 3-3 24 INCHES OF CASCADES INBD  $M = 10.72$   
 △ RUN NO 515A 3-4 12 INCHES OF CASCADES INBD  $M = 9.86$   
 ▽ RUN NO 515A 3-5 WITHOUT CASCADES  $M = 9.61$

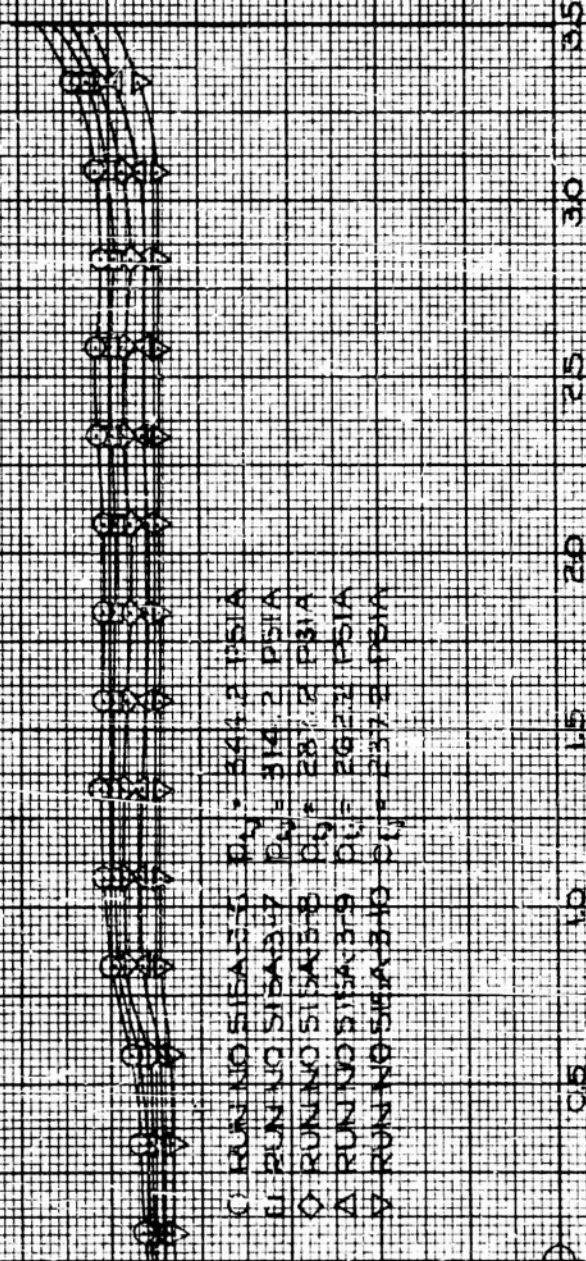
SLOT LENGTH - FEET

FIGURE 14

UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

# EFFECT OF JET PRESSURE VARIATION ON Suction Slot Quantity Distribution

VELOCITY x SLOT WIDTH - FT<sup>2</sup>/SEC



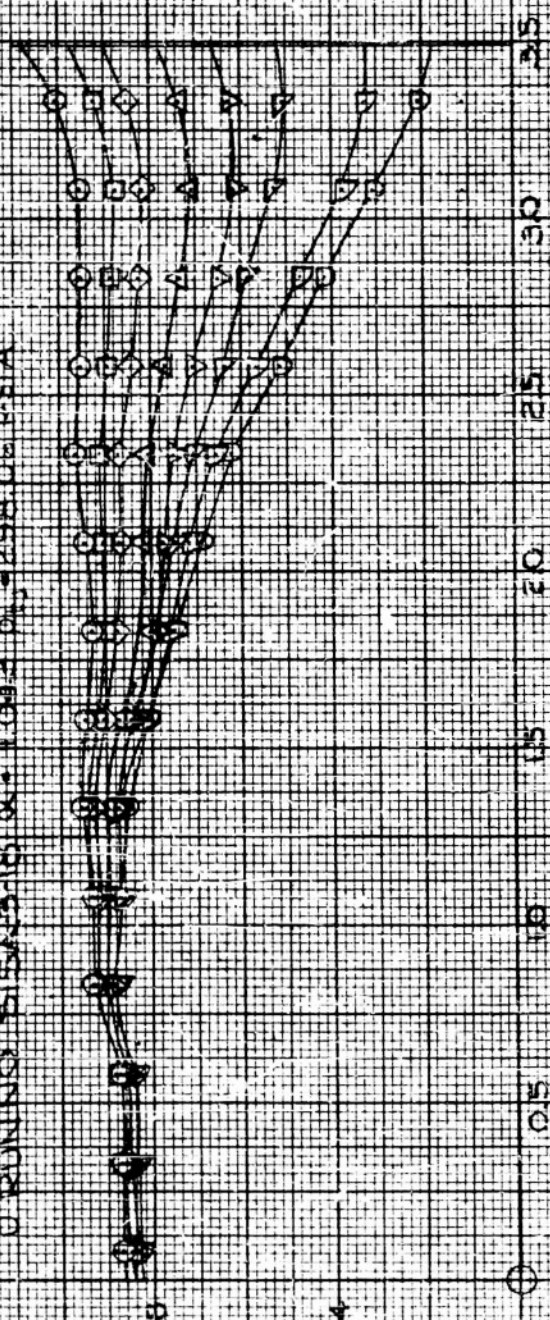


UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

EFFECT OF PRESSURE RATIO VARIATION  
ON SUCTION SLOT QUANTITY DISTRIBUTION

0 RUN NO. 515A-3-11	$\alpha = 1.013$	$P_{01} = 298.08$	PSIA
1 RUN NO. 515A-3-12	$\alpha = 1.017$	$P_{01} = 298.07$	PSIA
2 RUN NO. 515A-3-13	$\alpha = 1.021$	$P_{01} = 298.07$	PSIA
3 RUN NO. 515A-3-14	$\alpha = 1.025$	$P_{01} = 298.07$	PSIA
4 RUN NO. 515A-3-15	$\alpha = 1.030$	$P_{01} = 298.07$	PSIA
5 RUN NO. 515A-3-16	$\alpha = 1.034$	$P_{01} = 298.06$	PSIA
6 RUN NO. 515A-3-17	$\alpha = 1.039$	$P_{01} = 298.06$	PSIA
7 RUN NO. 515A-3-18	$\alpha = 1.043$	$P_{01} = 298.06$	PSIA

VELOCITY x SLOT WIDTH - FT<sup>2</sup>/SEC



SLOT LENGTH - FEET

FIGURE 1A (CONT'D)

C. HENNEY & ASSOCIATES

K&E  
REPLACES ESEB CO.  
10 X 10 TO THE 1/2 INCH

MODEL R 2.1  
328-11

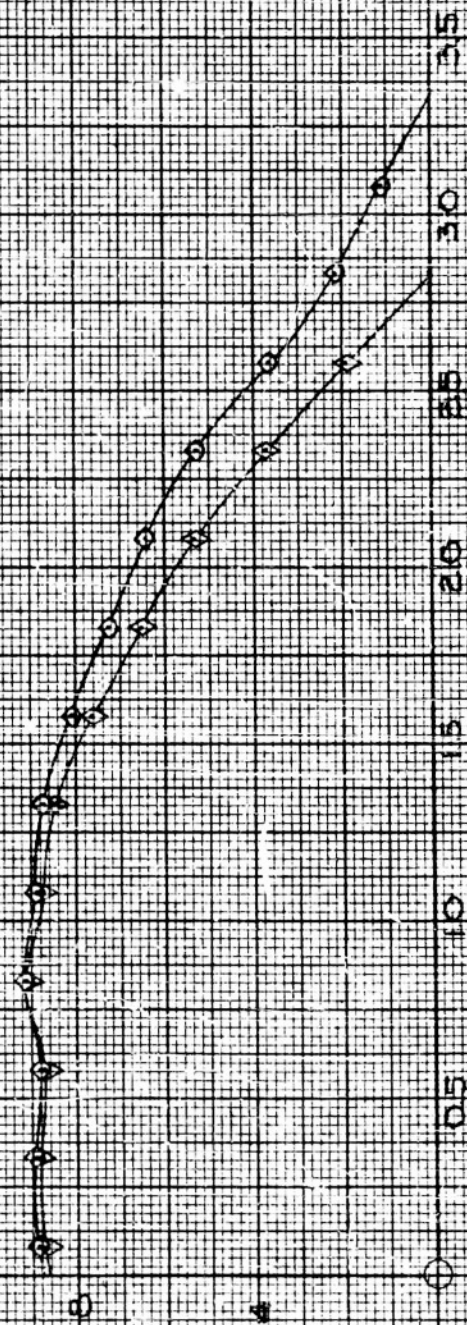
UNIVERSITY OF MICHIGAN  
SCHOOL OF ENGINEERING

# EFFECT OF PRESSURE RATIO VARIATION ON Suction Slot Quantity Distribution

0.0017 to 0.0255  
0.0017 to 0.0255

VELOCITY SLOTT LENGTH  $FT^2/SEC$

2  
0



SLOT LENGTH (FEET)

FIGURE 14 (CONT'D)

UNIVERSITY OF MICHIGAN



K.E

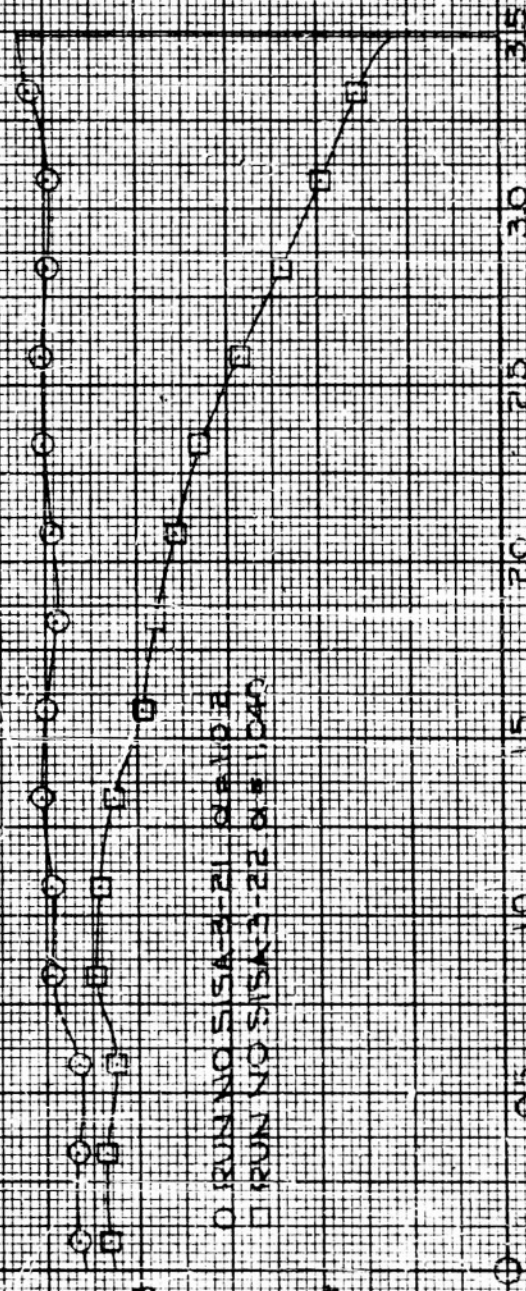
KEN-LEF & EBER CO.  
10 X 10 TO THE 1/2 INCH

2128-11

UNIVERSITY OF WISCONSIN  
SCHOOL OF ENGINEERING

# EFFECT OF PRESSURE RATIO VARIATION ON SUCTION SLOT QUANTITY DISTRIBUTION

VELOCITY X SLOT LENGTH - FT<sup>3</sup>/SEC

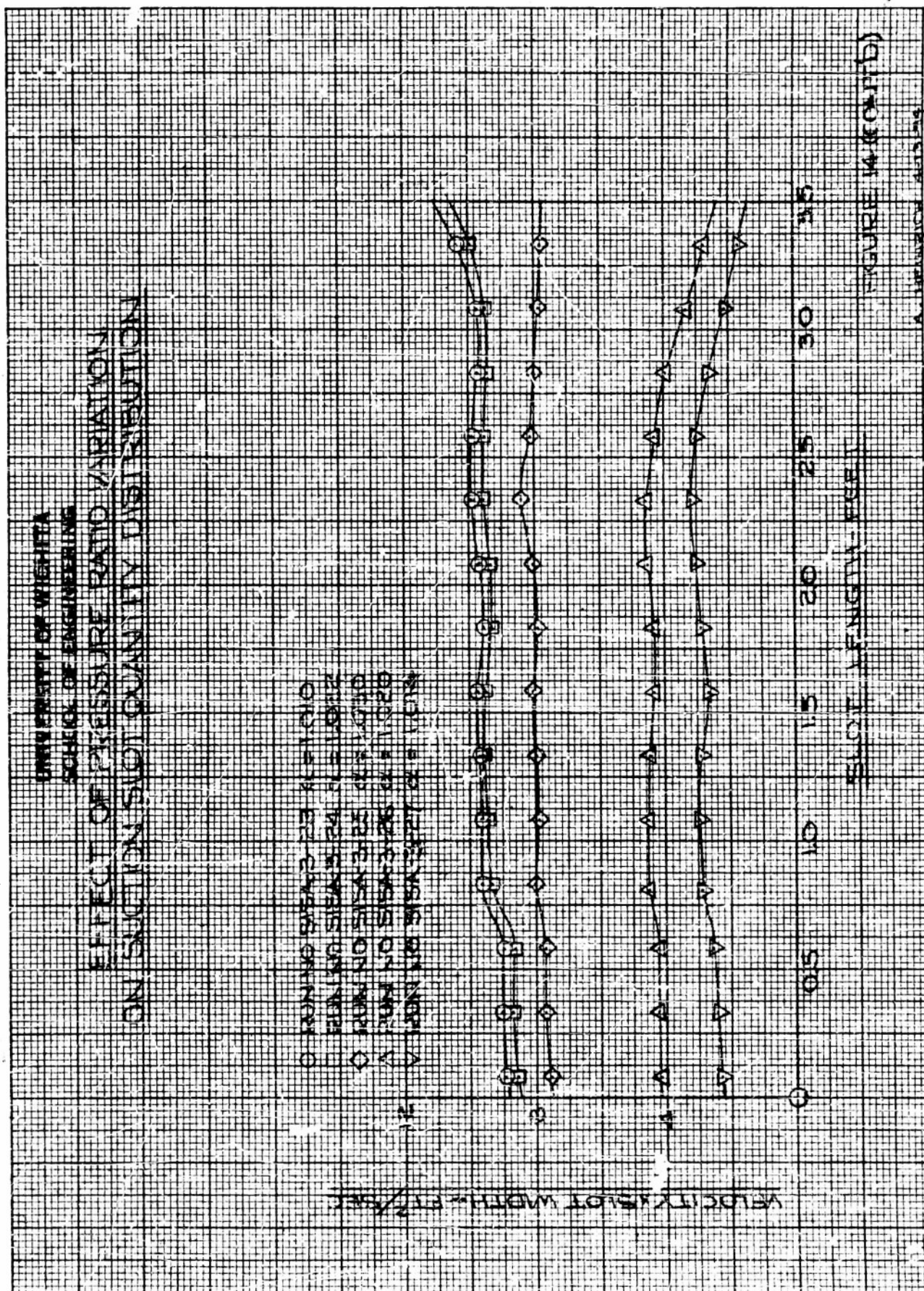


SLOT LENGTH - FEET

FIGURE 14 (CONT'D)

REVISION 2-6-54

FIGURE 14 (CONT'D)





K.E.  
KENTLETT & REESE CO.  
103 10 TO THE 1<sup>st</sup> INCH  
MODEL 8-21  
328-11

UNIVERSITY OF WISCONSIN  
SCHOOL OF ENGINEERING

# EFFECT OF PRESSURE RATIO VARIATION ON SUCTION SLOT QUANTITY DISTRIBUTION

VELOCITY \* SLOT WIDTH -  $F^2/SC$

○ RUN NO. 51A-B-28 Q=1.0225  
□ RUN NO. 51A-B-29 Q=1.050



SLOT LENGTH - FEET

FIGURE 1 (CONTINUED)

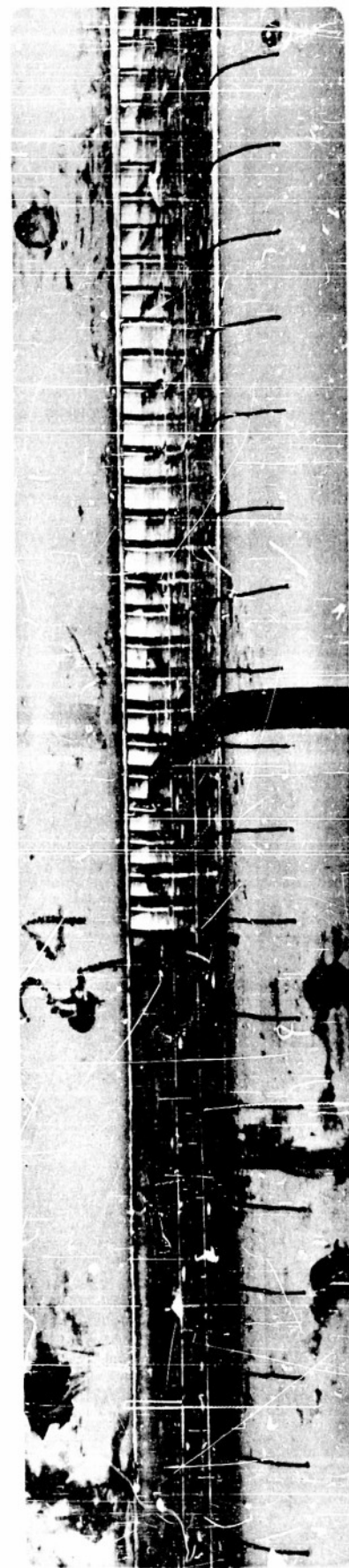
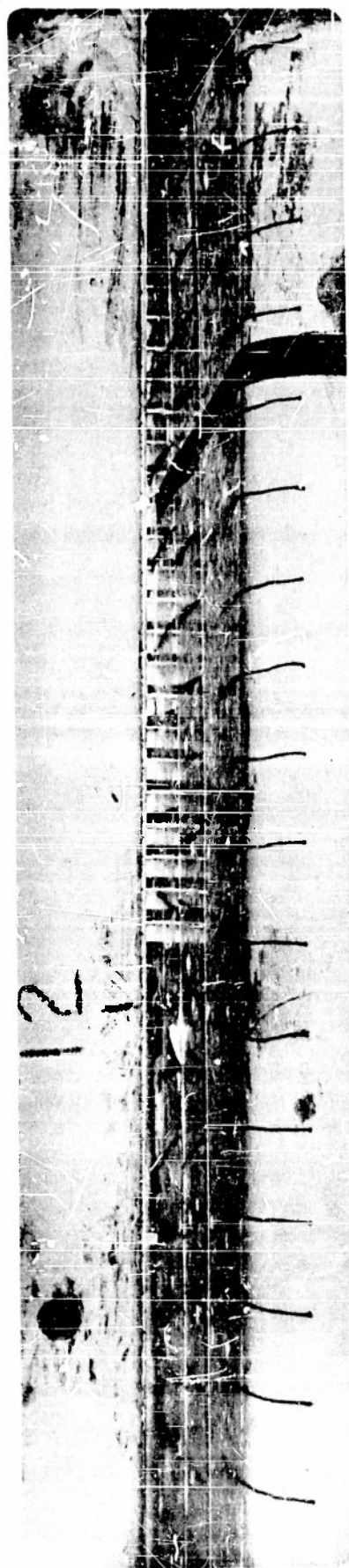


Figure 15.- Suction duct flow pattern.



K&E KENNEL & EGGES CO.  
10 1/2 TO 10 1/8 INCH  
320-11

UNIVERSITY OF WISCONSIN  
SCHOOL OF ENGINEERING

# MIXING TUBE ENTRANCE THROAT WIDTHS

— RUN S18A-3-20  
--- RUN S18A-3-21 & -22  
--- RUN S18A-3-23  
--- RUN S18A-3-24

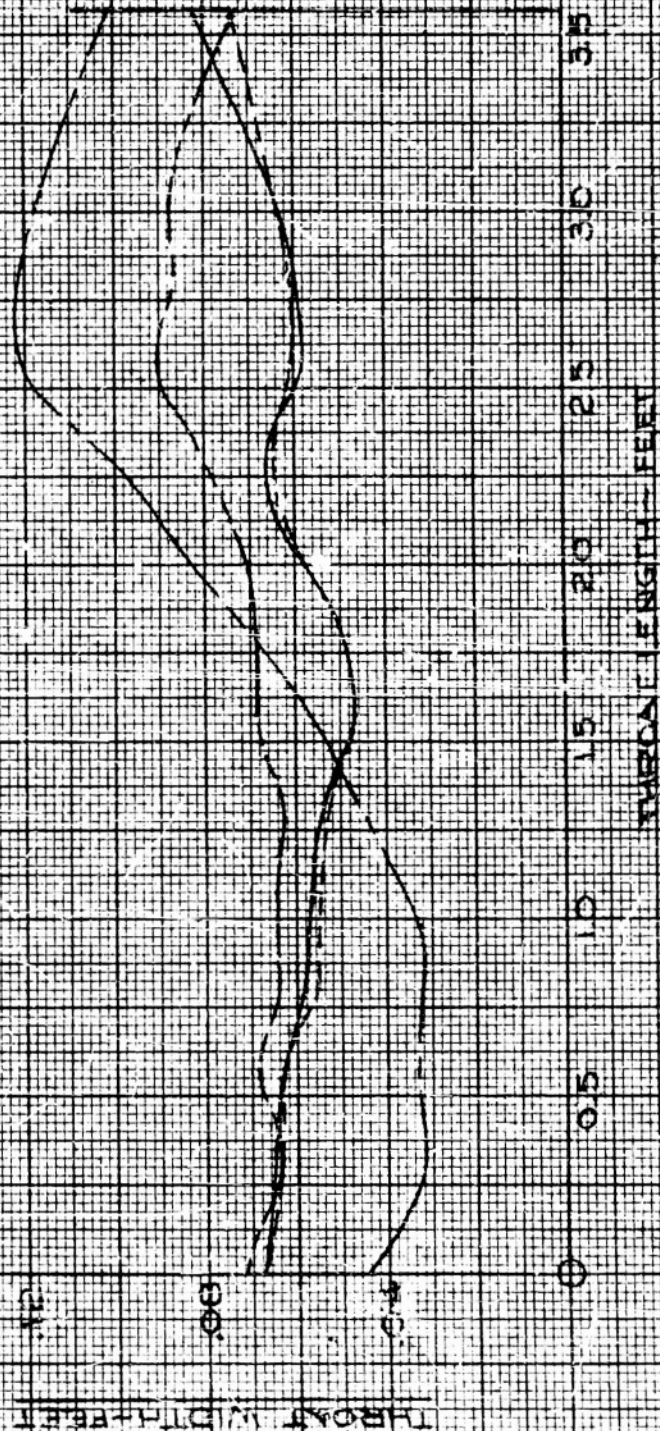


FIGURE 16

UNIVERSITY OF WISCONSIN

UNIVERSITY OF MICHIGAN  
SCHOOL OF ENGINEERING

# RELATIONSHIP OF CASCADES ON THROAT STATIC PRESSURE DISTRIBUTION

BY J. E. KELLEY

- RUN NO. 515A 1" WITH CASCADES
- RUN NO. 515A 3/4" SQUIGGLIES OF CASCADES IN RD
- ◇ RUN NO. 515A 3/4" SQUIGGLIES OF CASCADES IN RD
- △ RUN NO. 515A 3/4" SQUIGGLIES OF CASCADES IN RD
- ▽ RUN NO. 515A 3/4" WITHOUT CASCADES

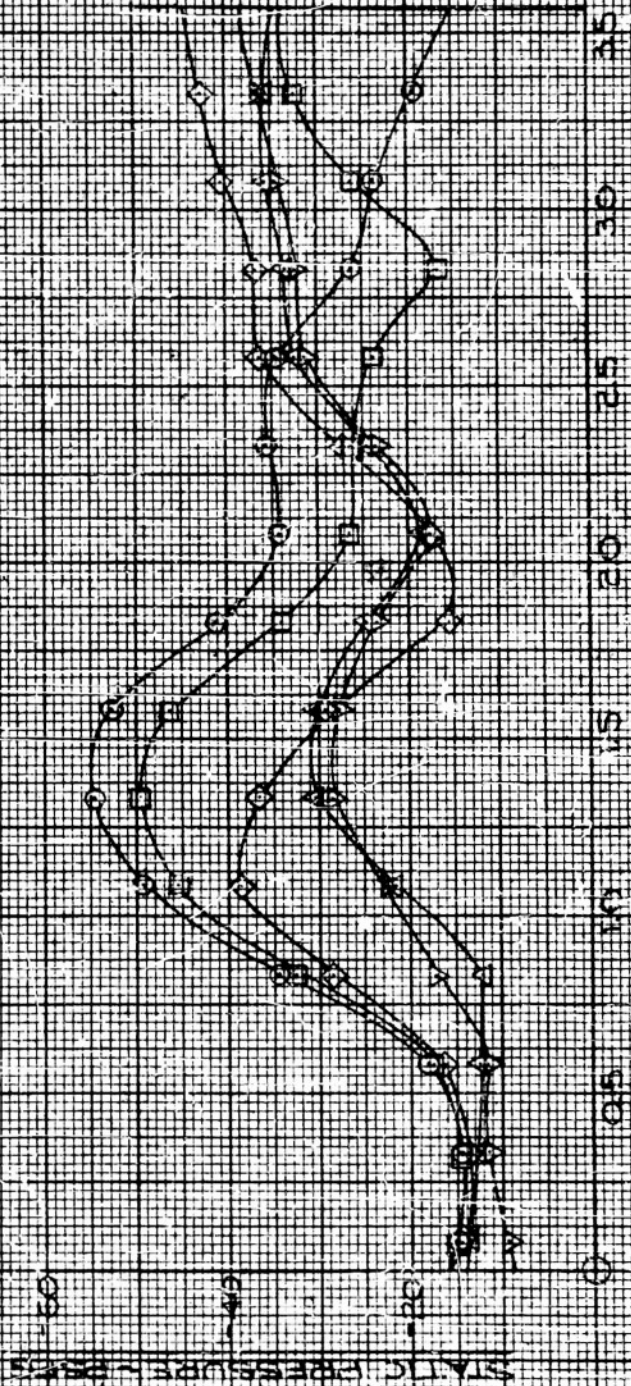


FIGURE 10  
RELATIONSHIP OF CASCADES  
ON THROAT STATIC PRESSURE DISTRIBUTION



K.E.

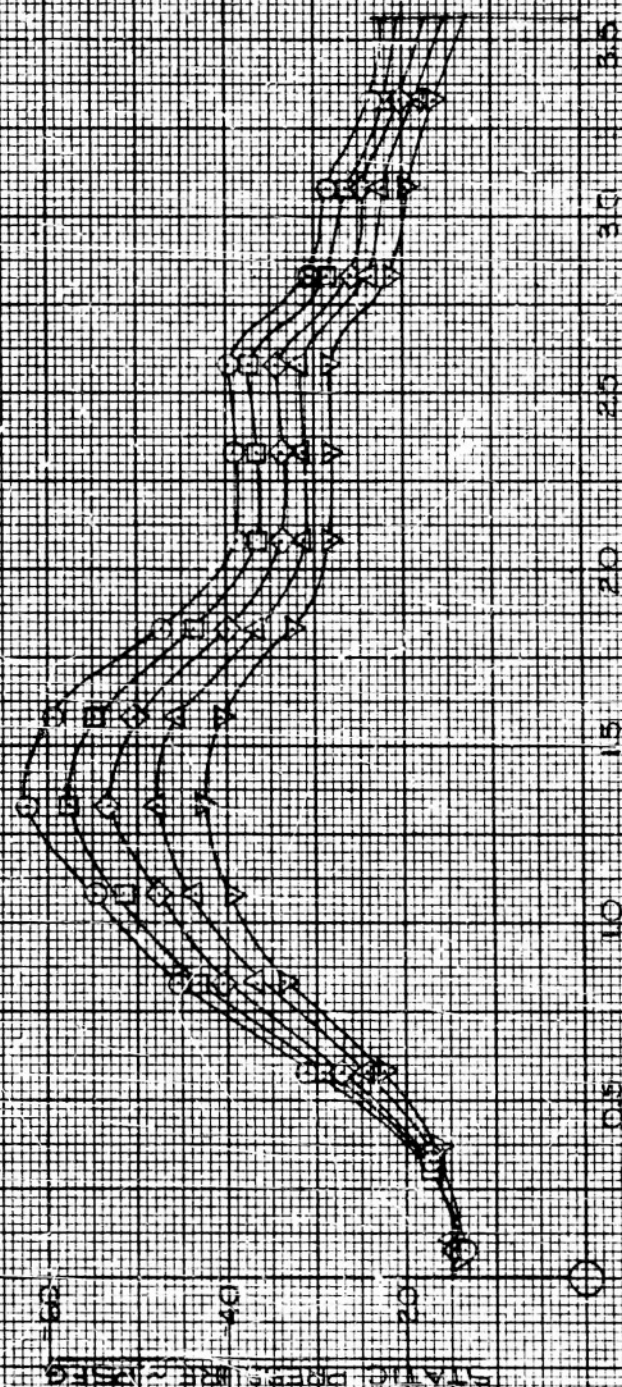
KEULEN & EBER CO.  
10 X 10 TO THE 1/4 INCH

228-12  
A. E. H. 1944

UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

# EFFECT OF UFT PRESSURE VARIATION ON THROAT STATIC PRESSURE DISTRIBUTION

○ RUN NO. 515A 3-4  $P_0 = 344.2$  PSIA  
 □ RUN NO. 515A 3-7  $P_0 = 314.2$  PSIA  
 ◇ RUN NO. 515A 3-8  $P_0 = 287.2$  PSIA  
 △ RUN NO. 515A 3-9  $P_0 = 232.2$  PSIA  
 ▼ RUN NO. 515A 3-10  $P_0 = 237.2$  PSIA



UNIVERSITY OF MICHIGAN  
SCHOOL OF ENGINEERING

# EFFECT OF PRESSURE RATIO VARIATION ON THROAT STATIC PRESSURE DISTRIBUTION

ORUN SISA-3-11 P. 29810 PSA M-1013  
 ORUN SISA-3-12 P. 29810 PSA M-1017  
 ORUN SISA-3-13 P. 29810 PSA M-1021  
 ORUN SISA-3-14 P. 29810 PSA M-1025  
 ORUN SISA-3-15 P. 29704 PSA M-1030  
 ORUN SISA-3-16 P. 29704 PSA M-1034  
 ORUN SISA-3-17 P. 29704 PSA M-1038  
 ORUN SISA-3-18 P. 29704 PSA M-1042

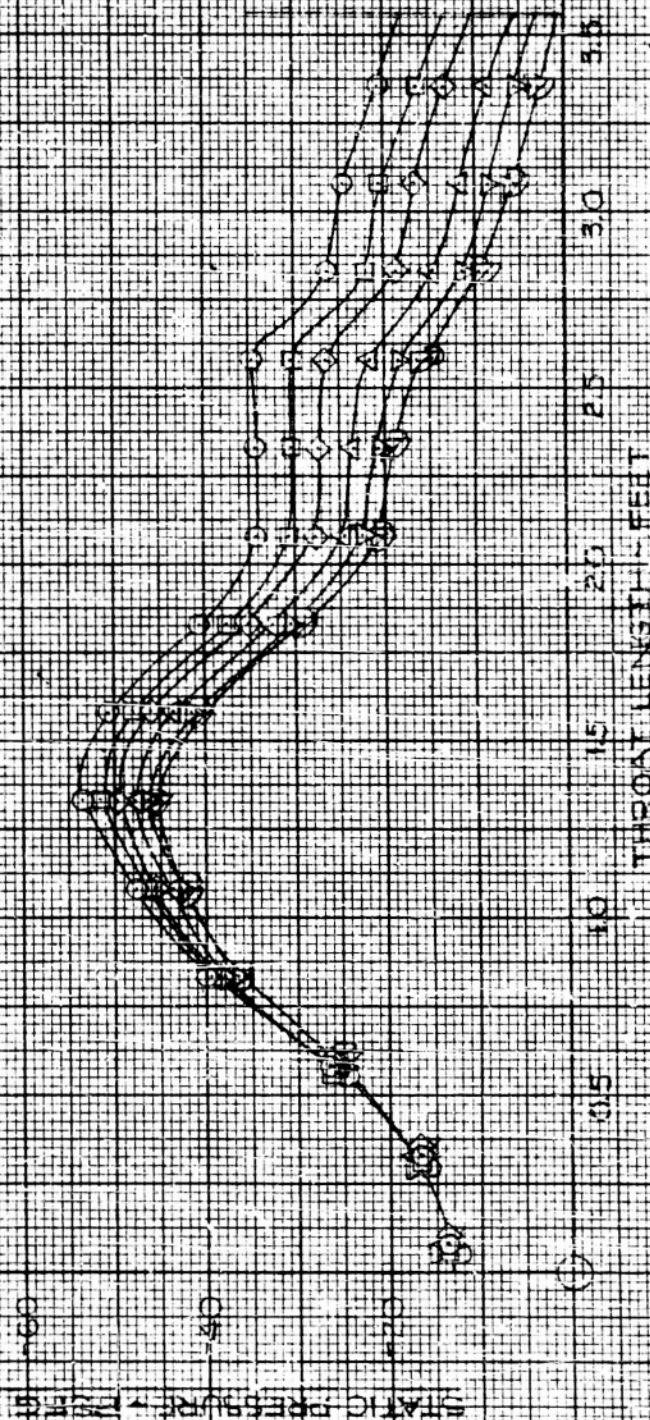


FIGURE 17 (CONT'D)



UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

EFFECT OF PRESSURE RATIO  
VARIATION ON THROAT  
STATIC PRESSURE

(WITH CONSTANT FLOW THROUGHOUT)

○ RUN NO. 515A-3-19  $\alpha = 1.000$   
□ RUN NO. 515A-3-20  $\alpha = 1.055$

STATIC PRESSURE - P<sub>stg</sub>

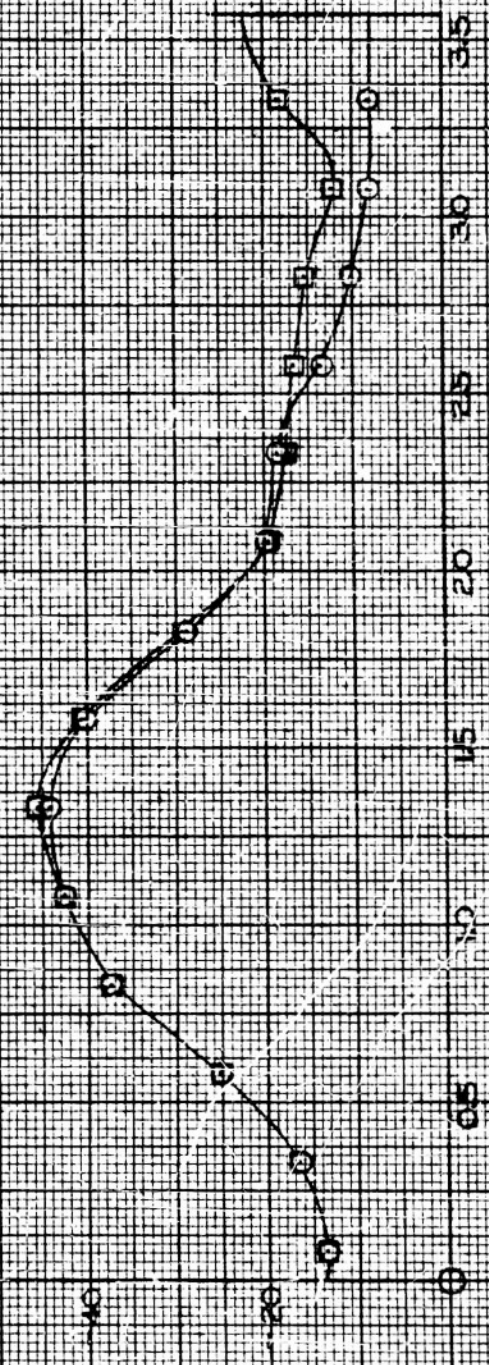
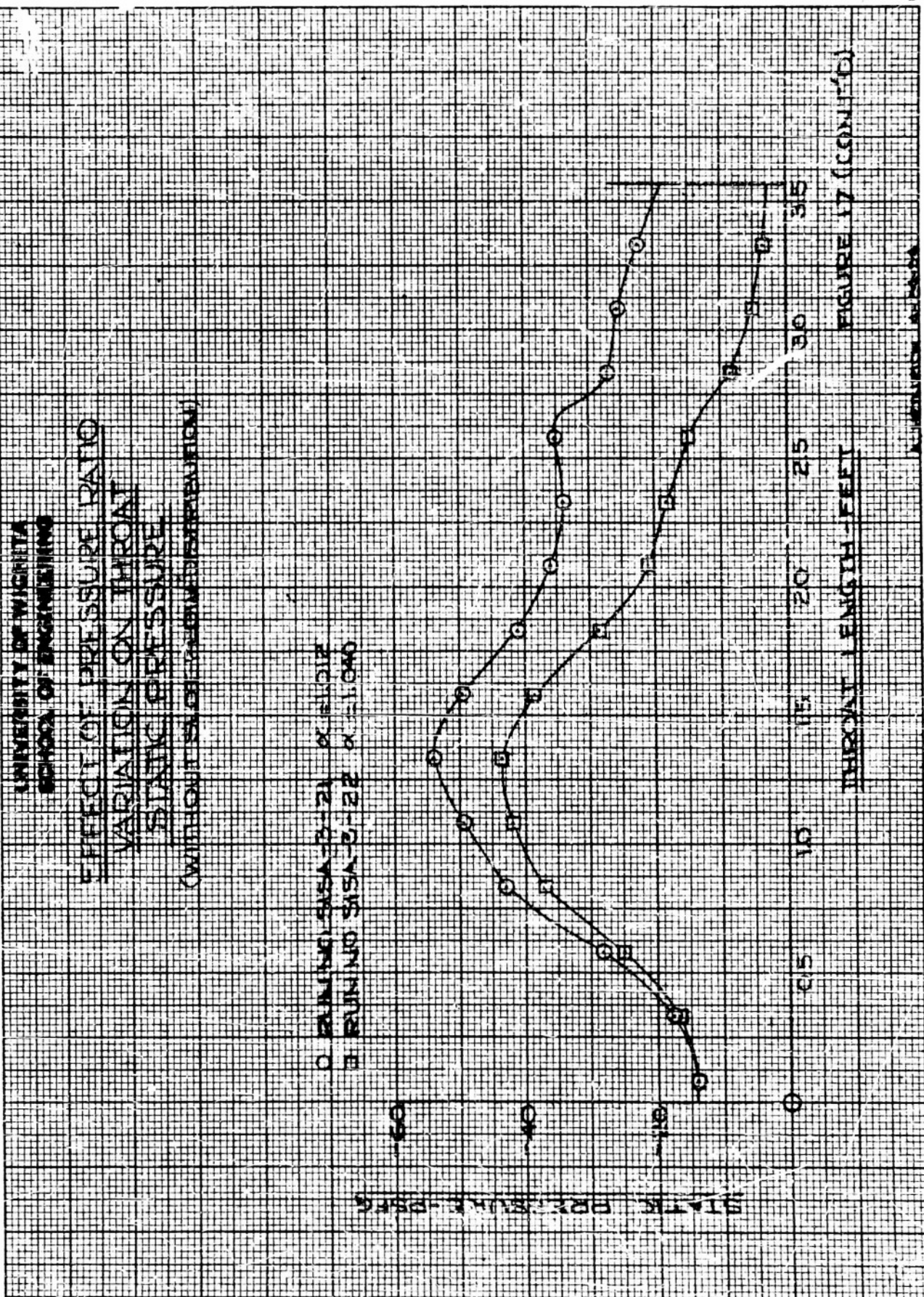


FIGURE 17 (CONT'D)



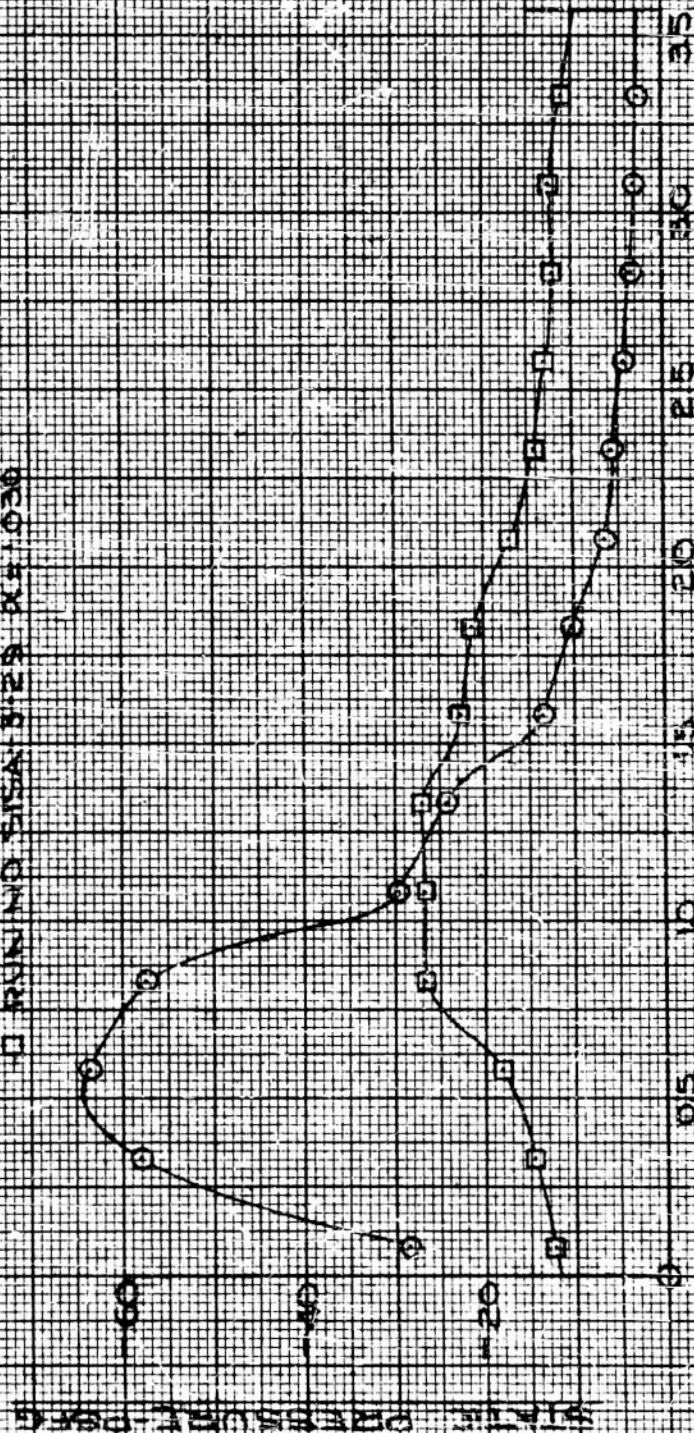


UNIVERSITY OF WICHITA  
 SCHOOL OF ENGINEERING

EFFECT OF PRESSURE RATIO  
 VARIATION ON THROAT  
 STATIC PRESSURE

WITH SLOT FLOW DISTRIBUTION

○ RUN NO 515A-3.28  $\alpha = 1.0265$   
 □ RUN NO 515A-3.28  $\alpha = 1.030$



THROAT VELOCITY - FEET

FIGURE 17 (CONC'D)



UNIVERSITY OF WISCONSIN  
SCHOOL OF ENGINEERING

EFFECT OF CASCADES  
ON MIXING TUBE  
STATIC PRESSURE DISTRIBUTION

$$P_{01} = 50.4 \text{ IN. H}_2\text{O}$$

- RUN NO. 515A-3-1 WITH CASCADES
- RUN NO. 515A-3-2 26 INCHES OF CASCADES INBD
- ◇ RUN NO. 515A-3-3 24 INCHES OF CASCADES INBD
- △ RUN NO. 515A-3-4 12 INCHES OF CASCADES INBD
- ▽ RUN NO. 515A-3-5 WITHOUT CASCADES

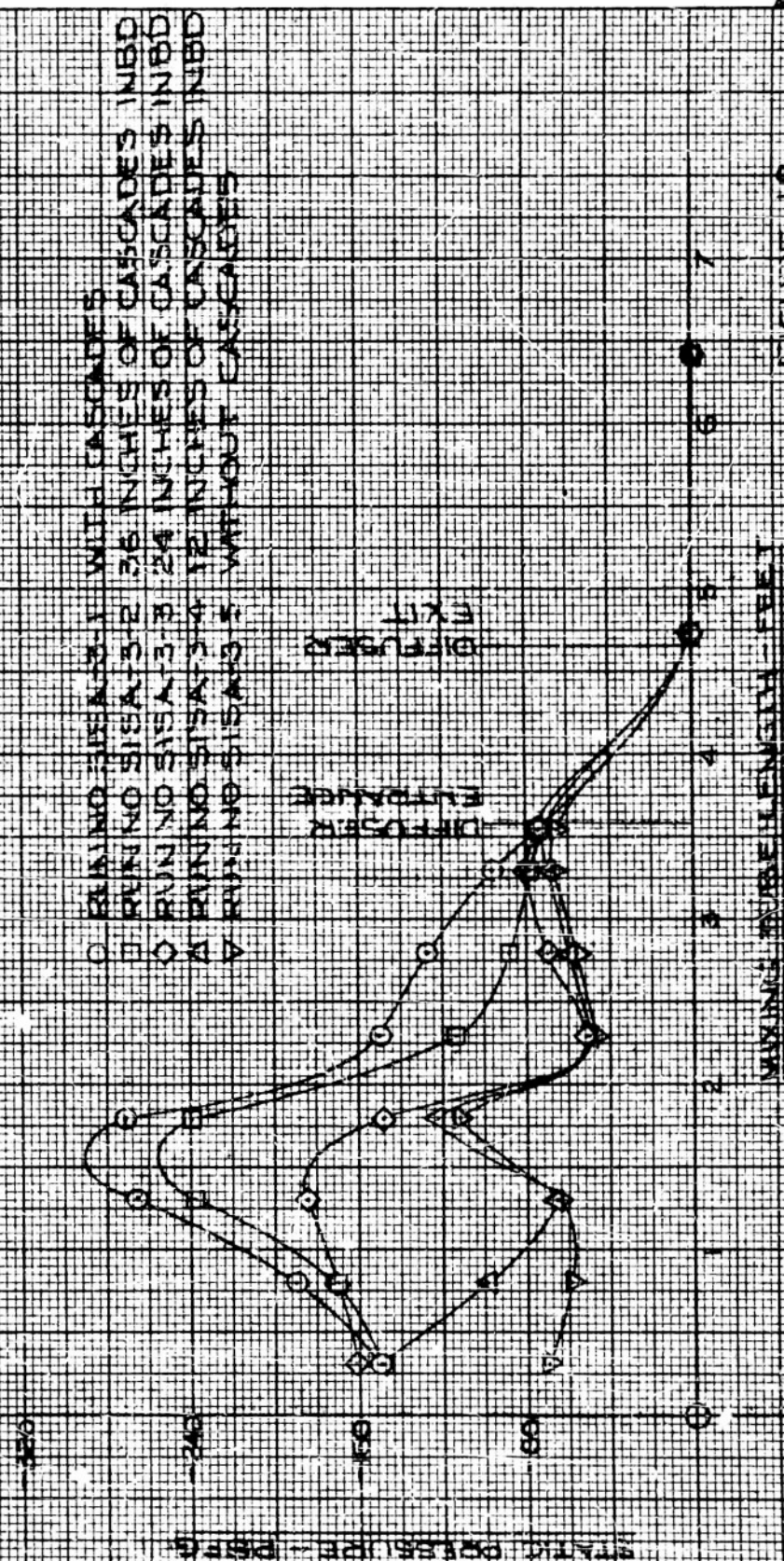


FIGURE 18

K.E. KENNEL & ESSER CO.  
10 X 10 TO ONE INCH 320-11

UNIVERSITY OF MICHIGAN  
SCHOOL OF ENGINEERING  
EFFECT OF JET PRESSURE  
VARIATION ON MIXING TUBE  
STATIC PRESSURE DISTRIBUTION

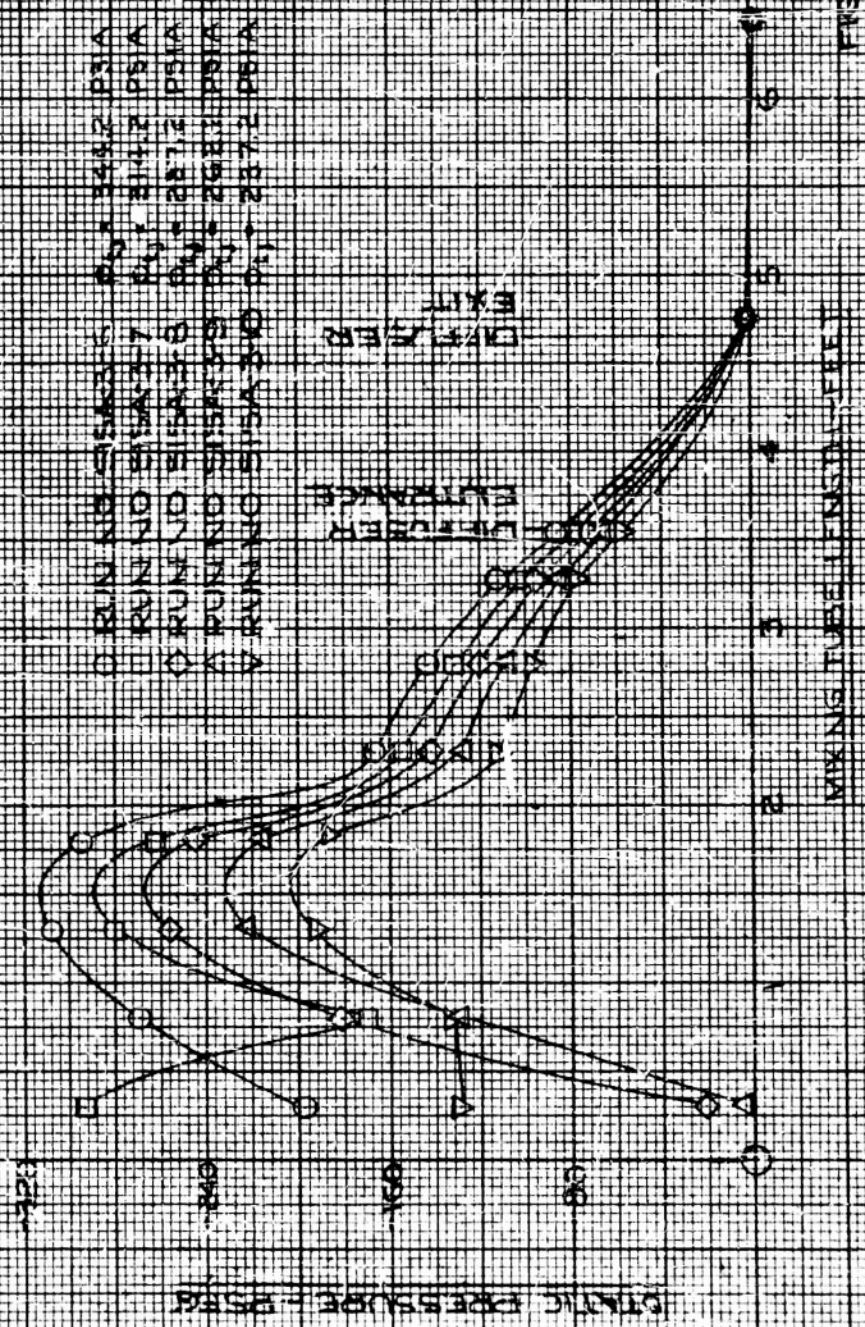


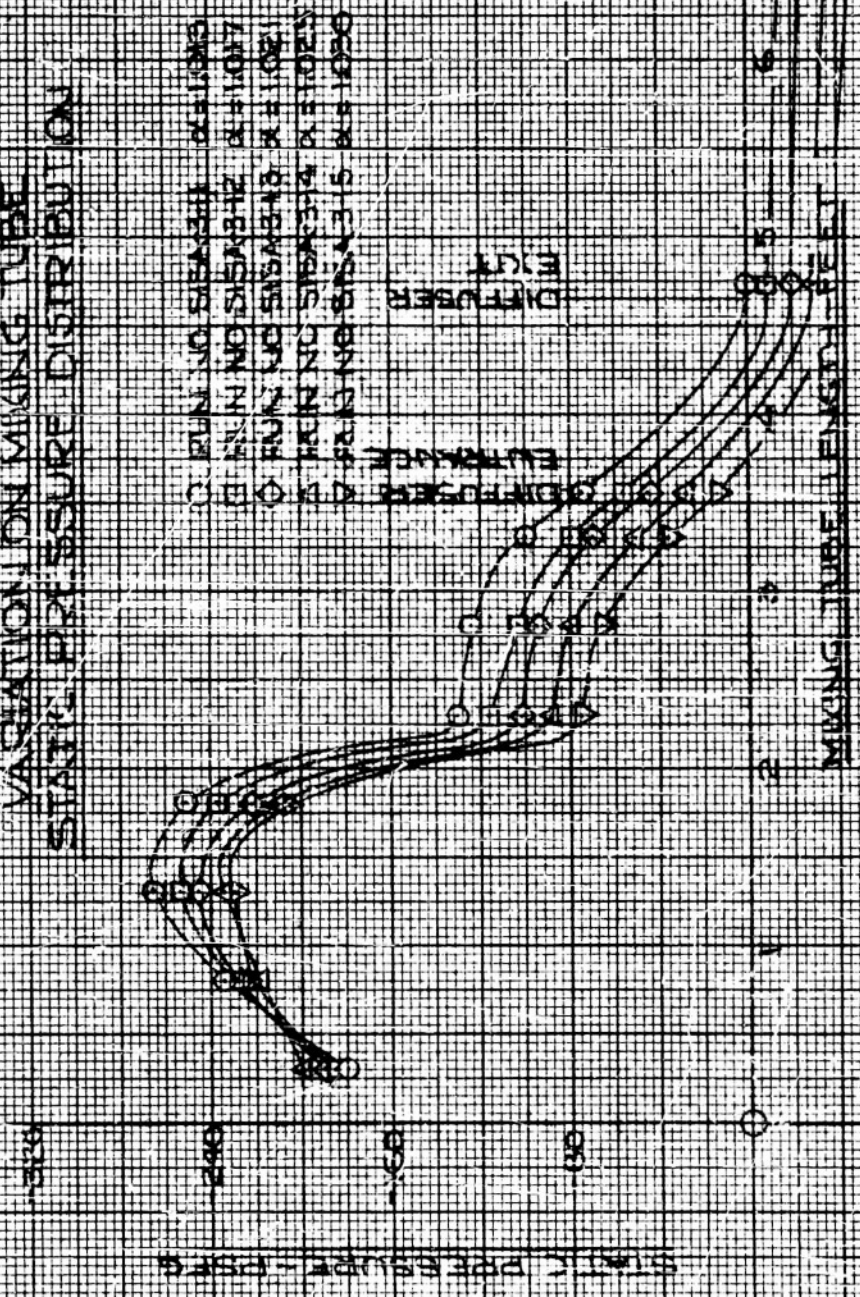
FIGURE 15 (CONT'D)

APR 1954



UNIVERSITY OF MINNAPOTA  
SCHOOL OF ENGINEERING

EFFECT OF PRESSURE RATIO  
VARIATION ON MIXING TUBE  
STATIC PRESSURE DISTRIBUTION



UNIVERSITY OF MINNAPOTA

# EFFECT OF PRESSURE RATIO VARIATION ON MIXING TUBE STATIC PRESSURE DISTRIBUTION





UNIVERSITY OF MICHIGAN  
SCHOOL OF ENGINEERING

EFFECT OF PRESSURE RATIO  
VARIATION ON MIXING TUBE  
STATIC PRESSURE DISTRIBUTION

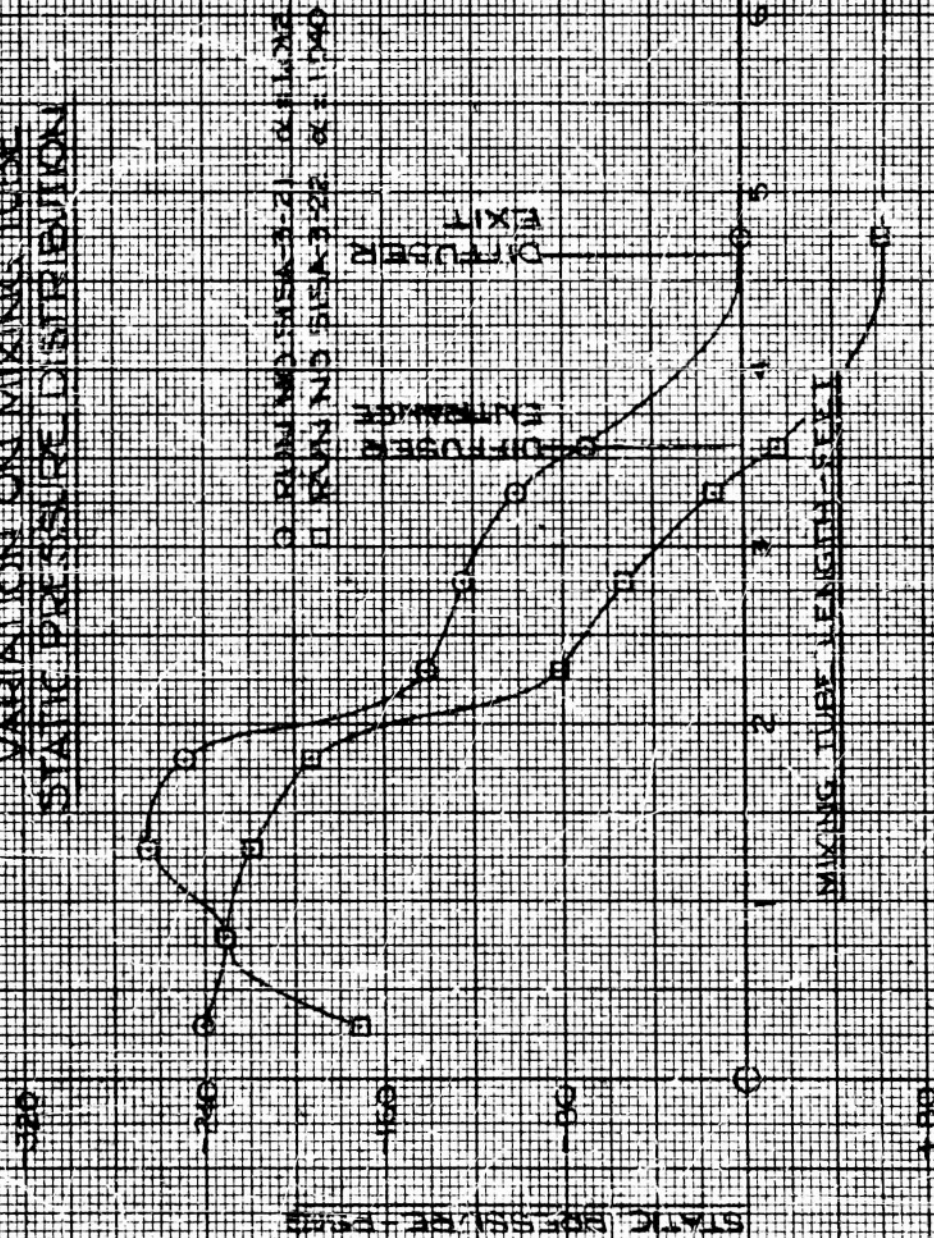


FIGURE 18 (CONT'D)

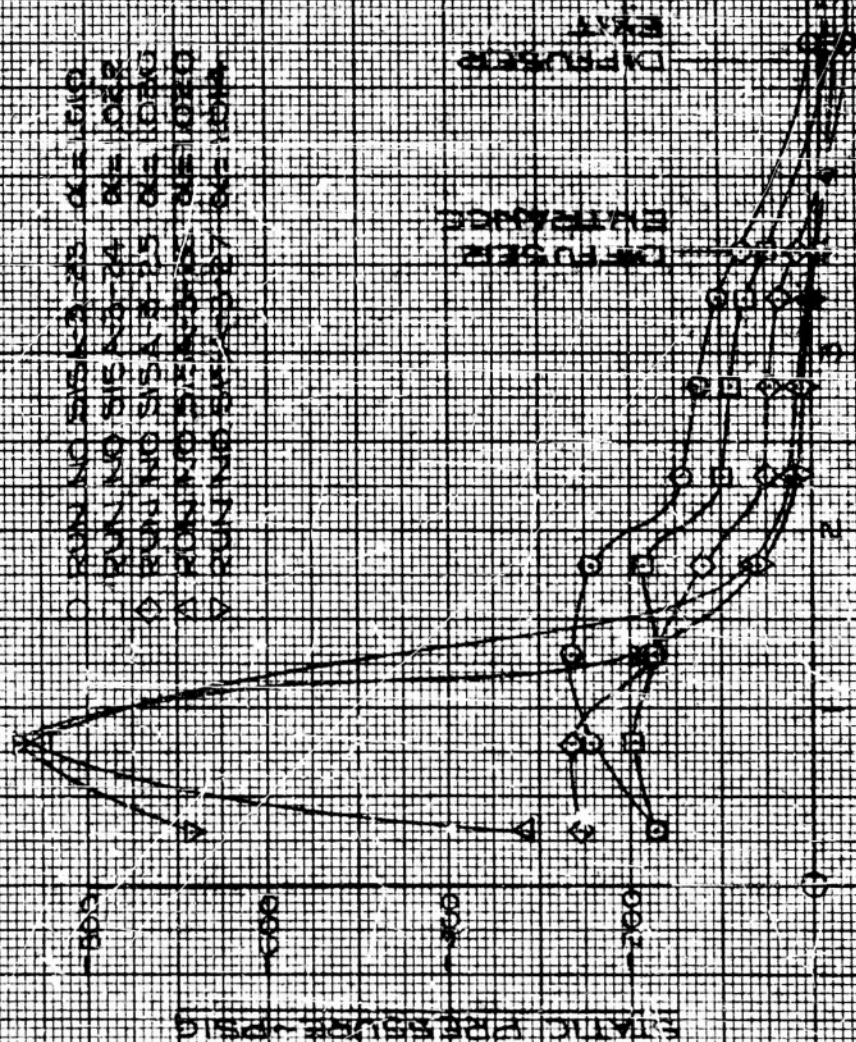


K&E  
VENTSEY & LEACH CO  
10 X 10 TO THE 1/2 INCH  
328-11  
MADE IN U.S.A.

UNIVERSITY OF MICHIGAN  
SCHOOL OF ENGINEERING

EFFECT OF PRESSURE RATIO  
VARIATION ON MIXING TIME  
STATIC PRESSURE DISTRIBUTION

○ RUN NO 2513-25 0.1-1.0  
○ RUN NO 2513-24 0.1-0.2  
○ RUN NO 2513-23 0.1-0.2  
○ RUN NO 2513-22 0.1-0.2  
○ RUN NO 2513-21 0.1-0.2  
○ RUN NO 2513-20 0.1-0.2  
○ RUN NO 2513-19 0.1-0.2  
○ RUN NO 2513-18 0.1-0.2  
○ RUN NO 2513-17 0.1-0.2  
○ RUN NO 2513-16 0.1-0.2  
○ RUN NO 2513-15 0.1-0.2  
○ RUN NO 2513-14 0.1-0.2  
○ RUN NO 2513-13 0.1-0.2  
○ RUN NO 2513-12 0.1-0.2  
○ RUN NO 2513-11 0.1-0.2  
○ RUN NO 2513-10 0.1-0.2  
○ RUN NO 2513-9 0.1-0.2  
○ RUN NO 2513-8 0.1-0.2  
○ RUN NO 2513-7 0.1-0.2  
○ RUN NO 2513-6 0.1-0.2  
○ RUN NO 2513-5 0.1-0.2  
○ RUN NO 2513-4 0.1-0.2  
○ RUN NO 2513-3 0.1-0.2  
○ RUN NO 2513-2 0.1-0.2  
○ RUN NO 2513-1 0.1-0.2



Average Tube Length - Feet

Pressure Ratio (0.1-1.0)



UNIVERSITY OF MICHIGAN  
DEPARTMENT OF MECHANICAL ENGINEERING  
EFFECT OF PRESSURE RATIO  
VARIATION ON MIXING TIME  
STATIC PRESSURE DISTRIBUTION

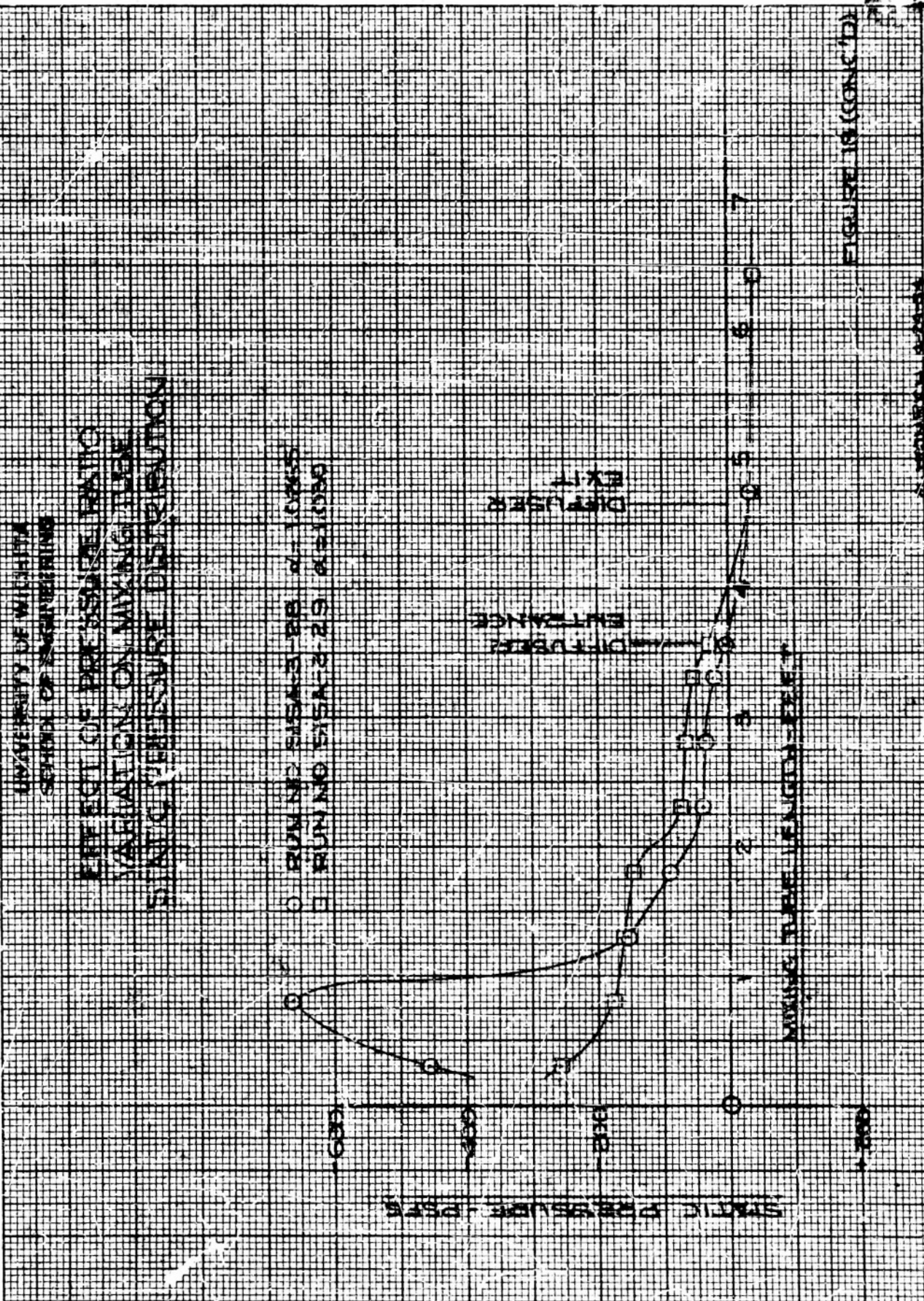
0 RUN NO. 518-2-25-10005  
0 RUN NO. 518-2-25-10005

STATIC PRESSURE - PSF

MIXING TUBE LENGTH - FEET

DIFFUSER  
ENTRANCE

FIGURE 16 (CONC'D)

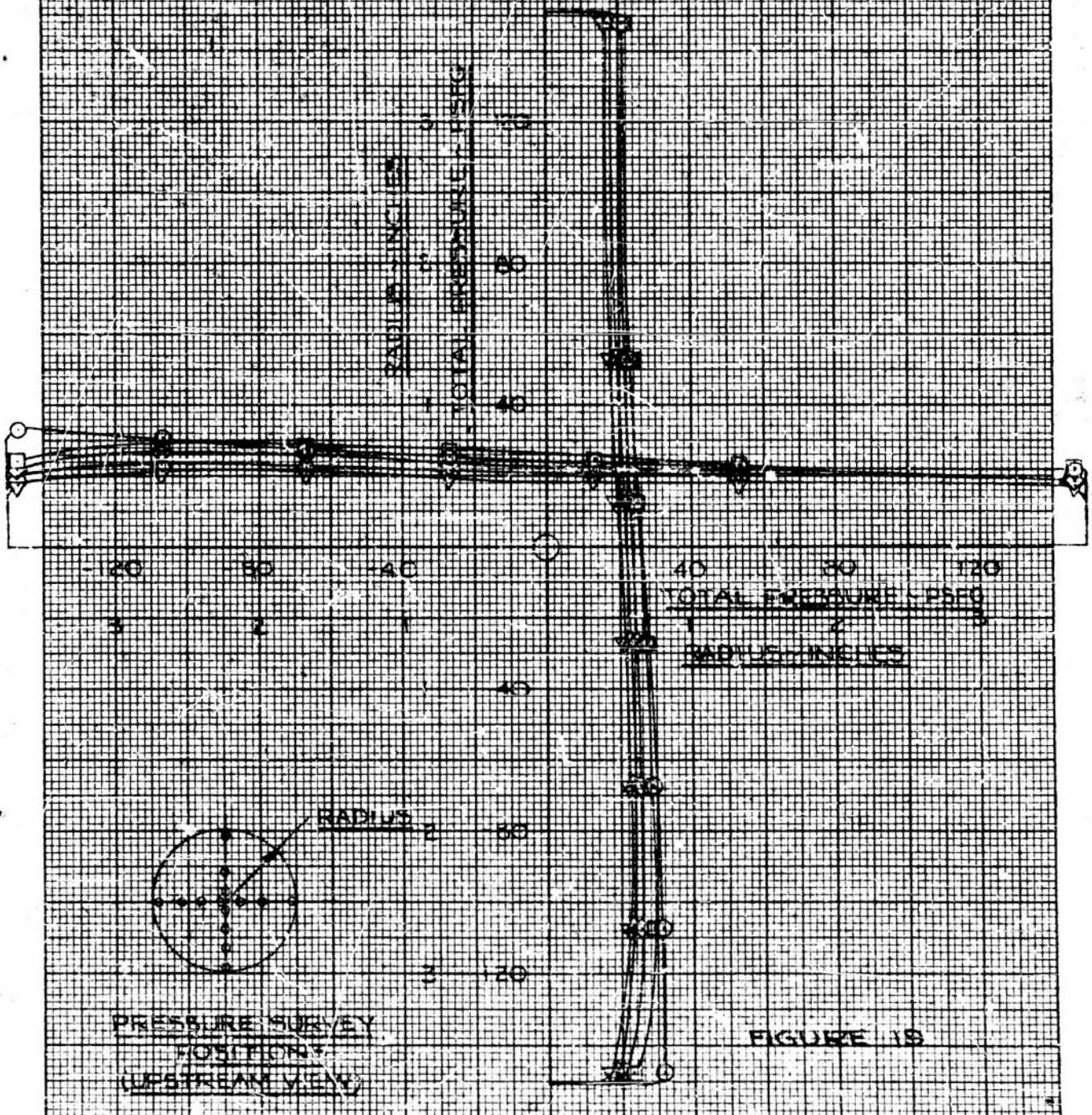




UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

STA F  
PRESSURE DISTRIBUTION

ORUNNO SISA 3-6 R = 344.2 PSIA  
ORUNNO SISA 3-7 R = 344.2 PSIA  
ORUNNO SISA 3-8 R = 287.2 PSIA  
ARUNNO SISA 3-9 R = 287.2 PSIA  
ORUNNO SISA 3-10 R = 287.2 PSIA

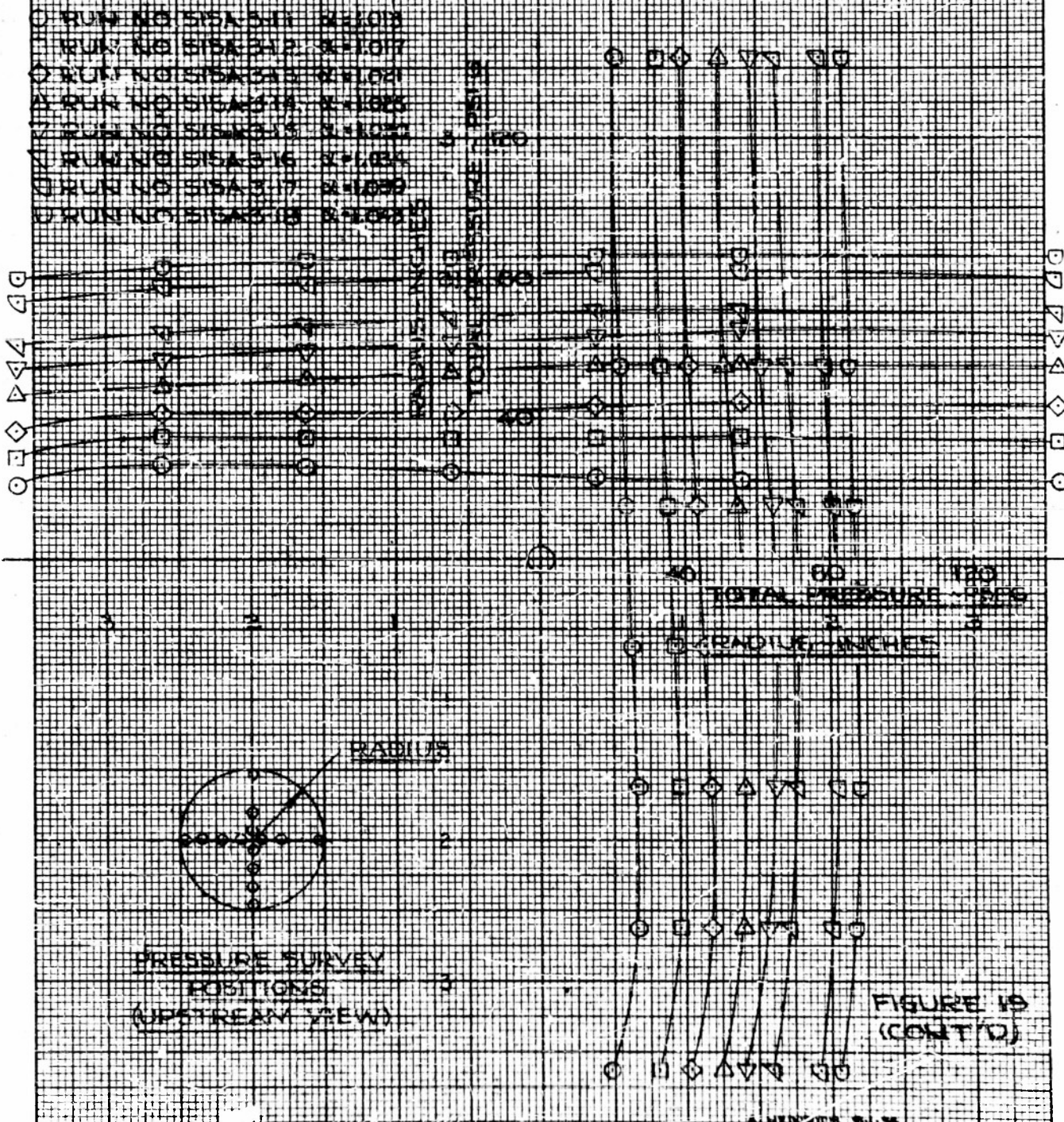




UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

STA F

PRESSURE DISTRIBUTION





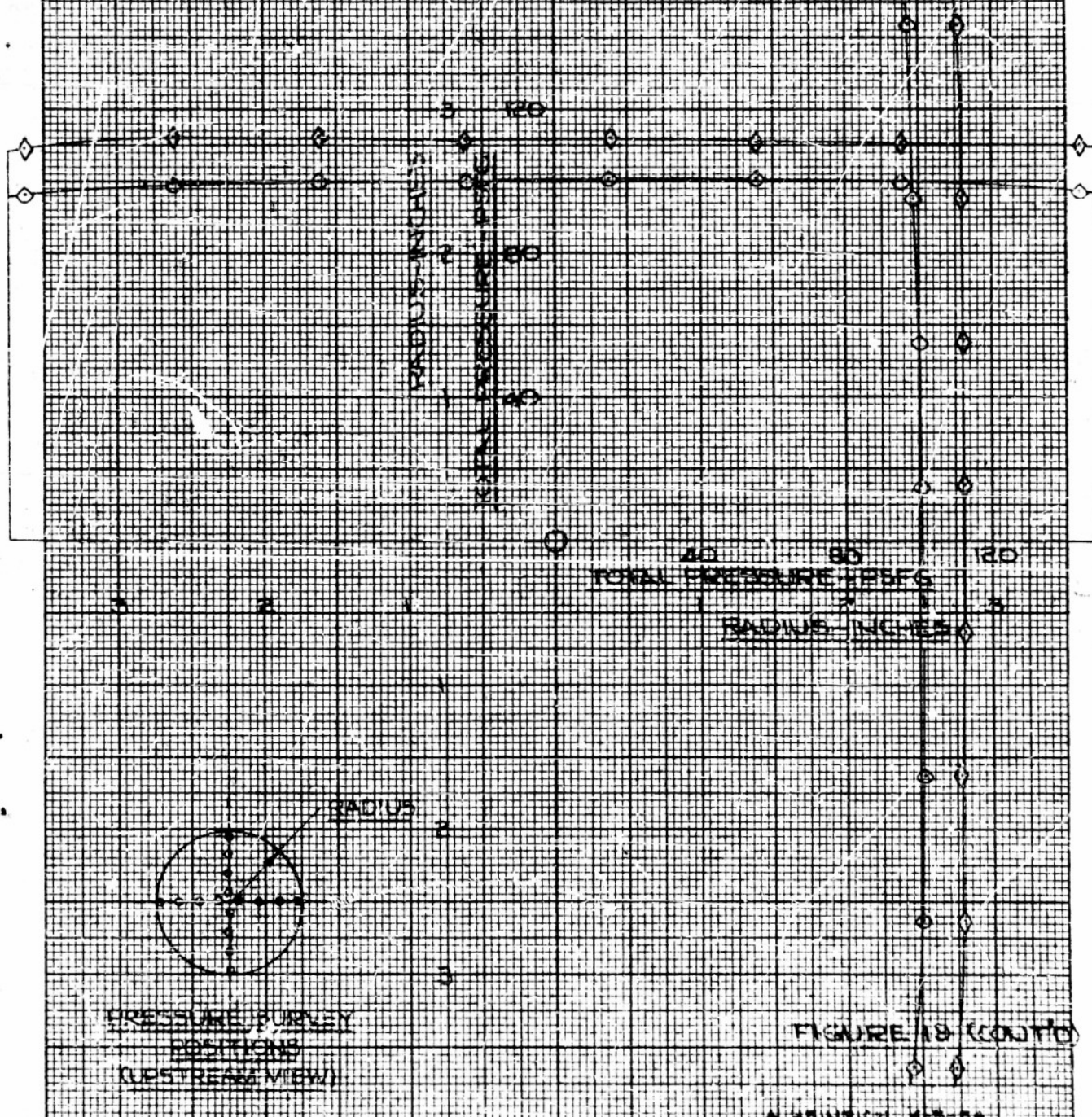
UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

## STAFF

## PRESSURE DISTRIBUTION

RUN NO. SF5A-819  $\alpha = 1.050$

RUN NO. S-5A-3-20  $\alpha = 1.050$



K.E.

KIMBLE &amp; BROWN CO.

MADE IN U.S.A.  
328-11

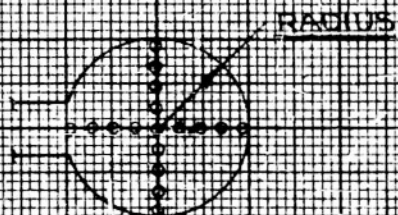
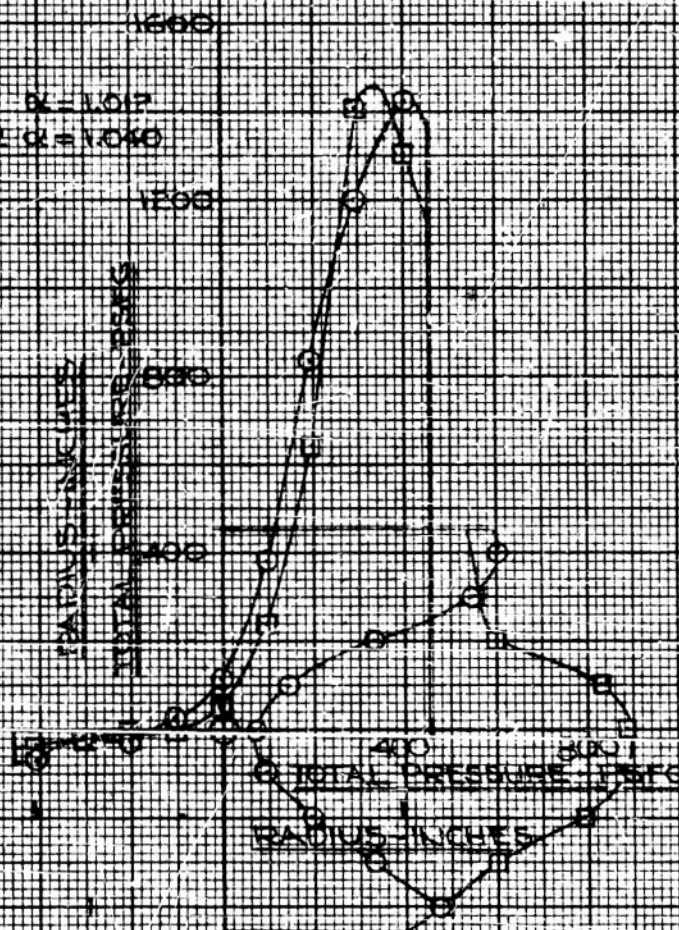


UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

STA A

PRESSURE DISTRIBUTION

O RUN NO 515A-3-21  $\alpha = 1.017$   
 II RUN NO 515A-3-22  $\alpha = 1.040$



PRESSURE SURVEY  
 POINTS  
 (SEE TRAIL VIEW)

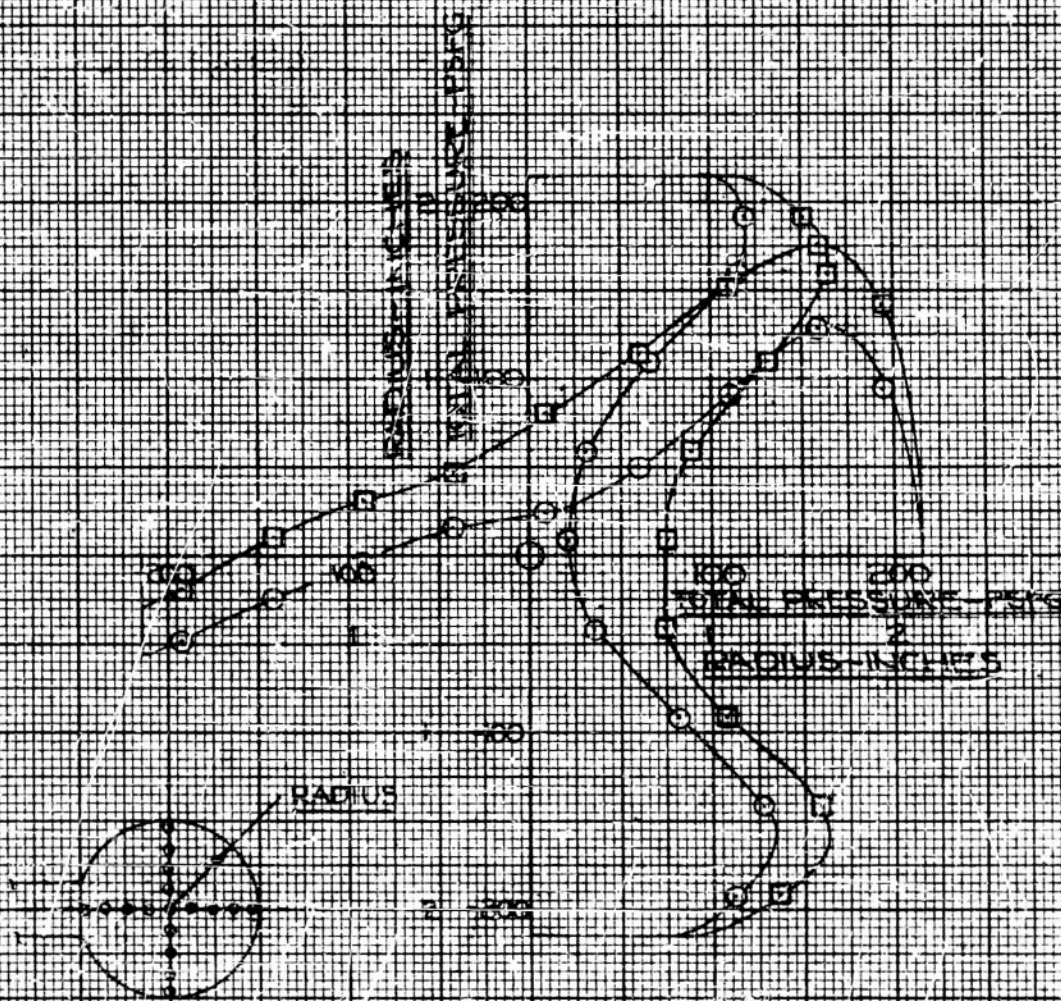
FIGURE 13 (CONTD)





UNIVERSITY OF NICKITA  
SCHOOL OF ENGINEERING  
STA C  
PRESSURE DISTRIBUTION

0 DIA NO 51A-221 OF 1.012  
1 RUN NO 51A-22 OF 1.040



PRESSURE SURVEY  
POSITION  
(UPSTREAM VIEW)

FIGURE 13 (CONT'D)



UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

STA D  
PRESSURE DISTRIBUTION

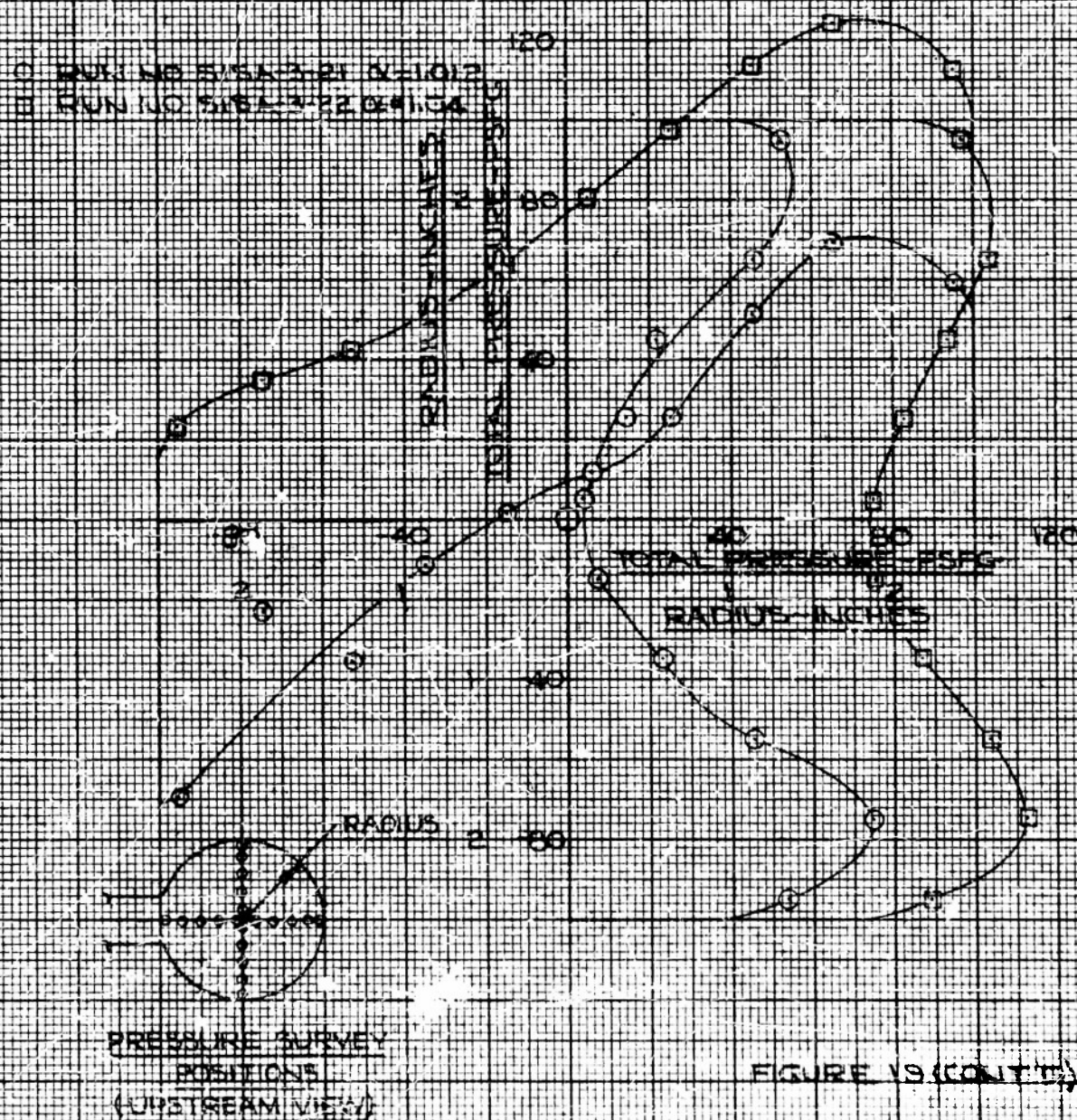


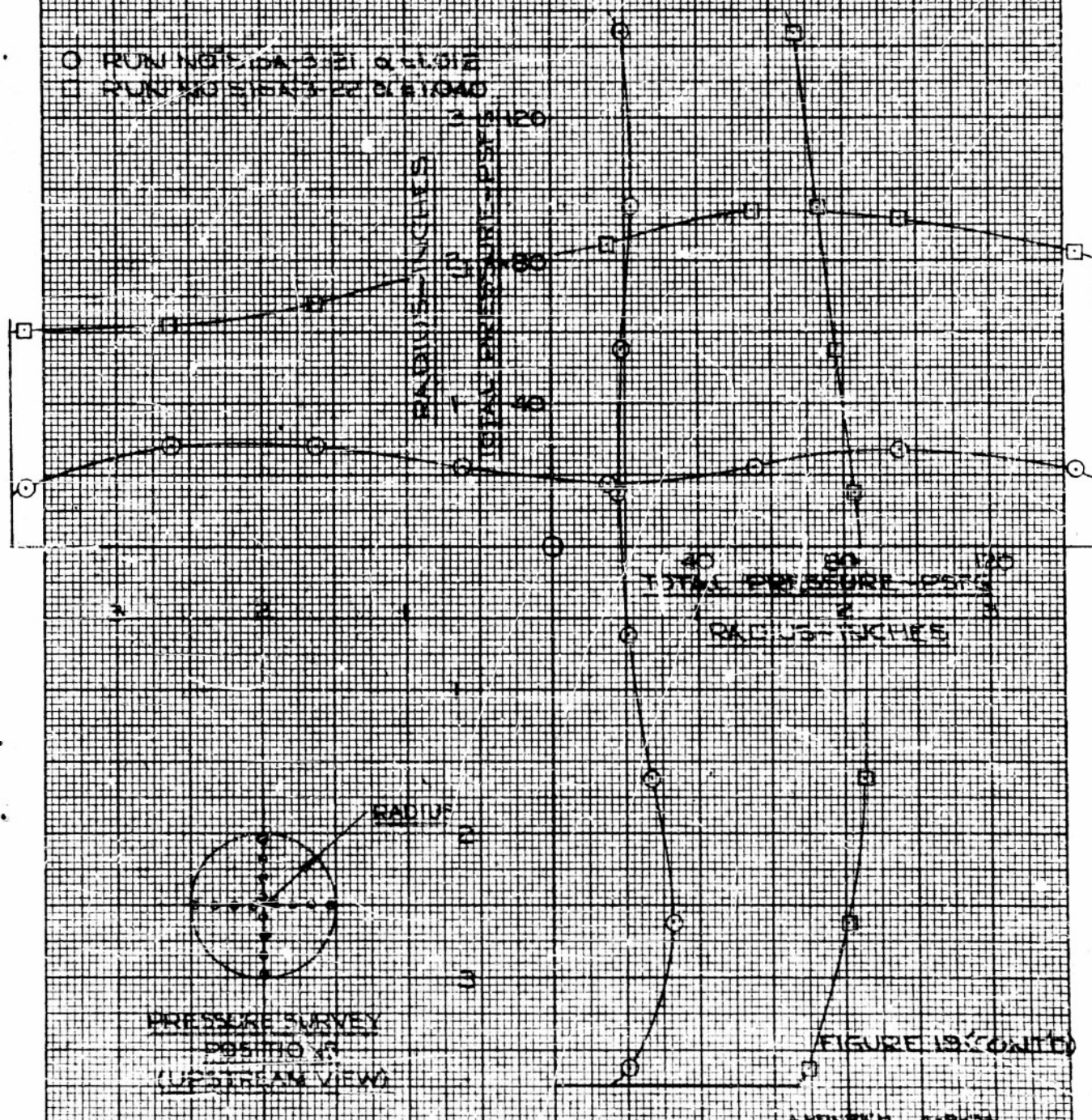
FIGURE 19 (CONT.)

R. HEINRICH 8-2-55



UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

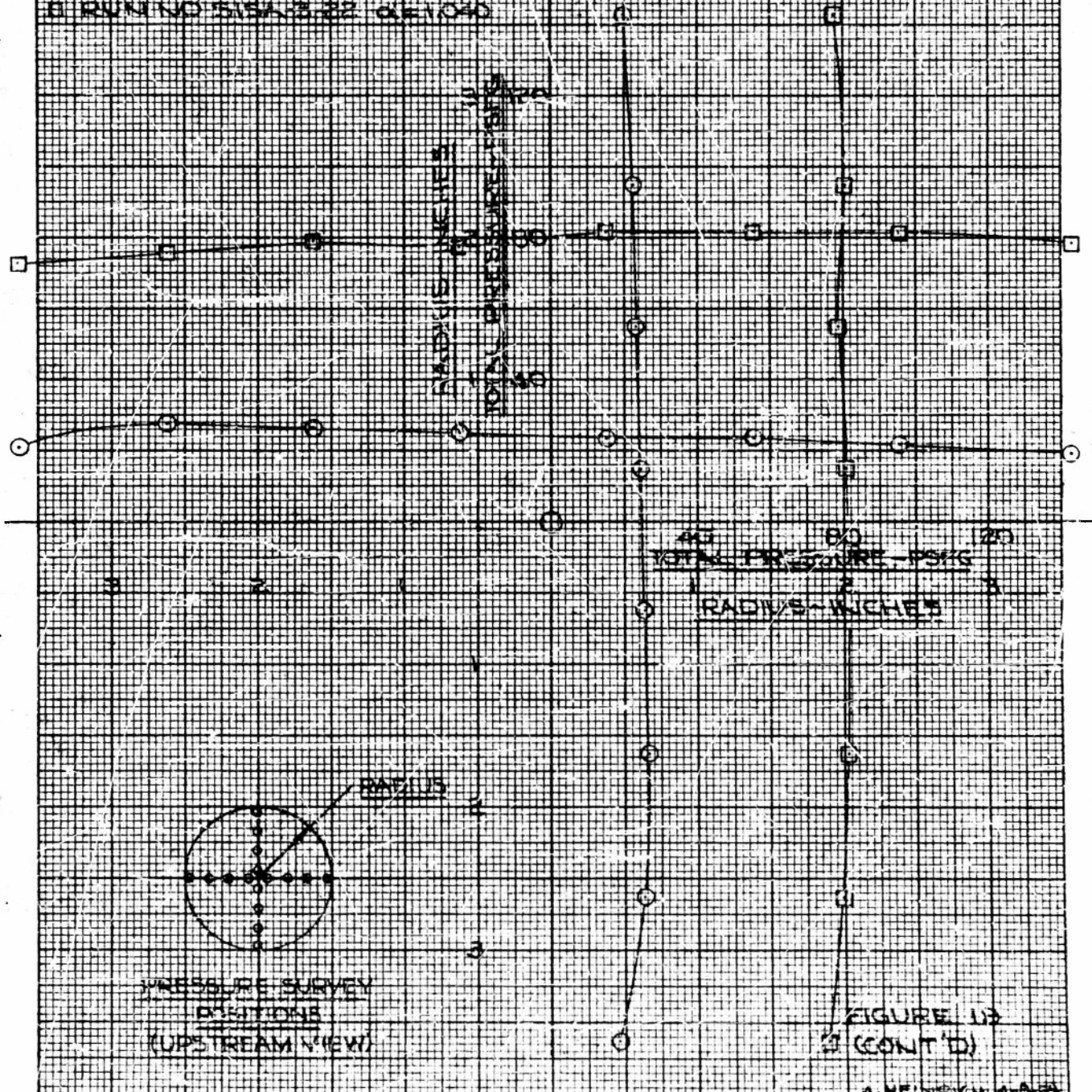
STA E  
PRESSURE DISTRIBUTION





UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING  
**STAFF**  
PRESSURE DISTRIBUTION

0 RUN NO 515A-3.21 Q=1012  
0 RUN NO 515A-3.22 Q=1040





UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

STA F

PRESSURE DISTRIBUTION

○ RUN NO. 154-3-23 Q = 10.5  
□ RUN NO. 154-3-24 Q = 10.22  
◇ RUN NO. 154-3-25 Q = 10.39  
△ RUN NO. 154-3-26 Q = 10.28  
▽ RUN NO. 154-3-27 Q = 10.28

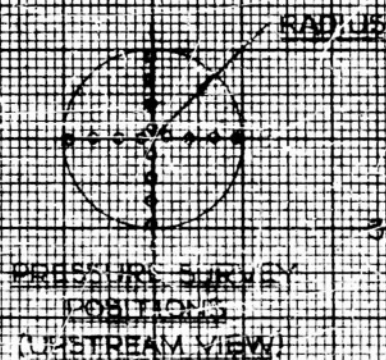
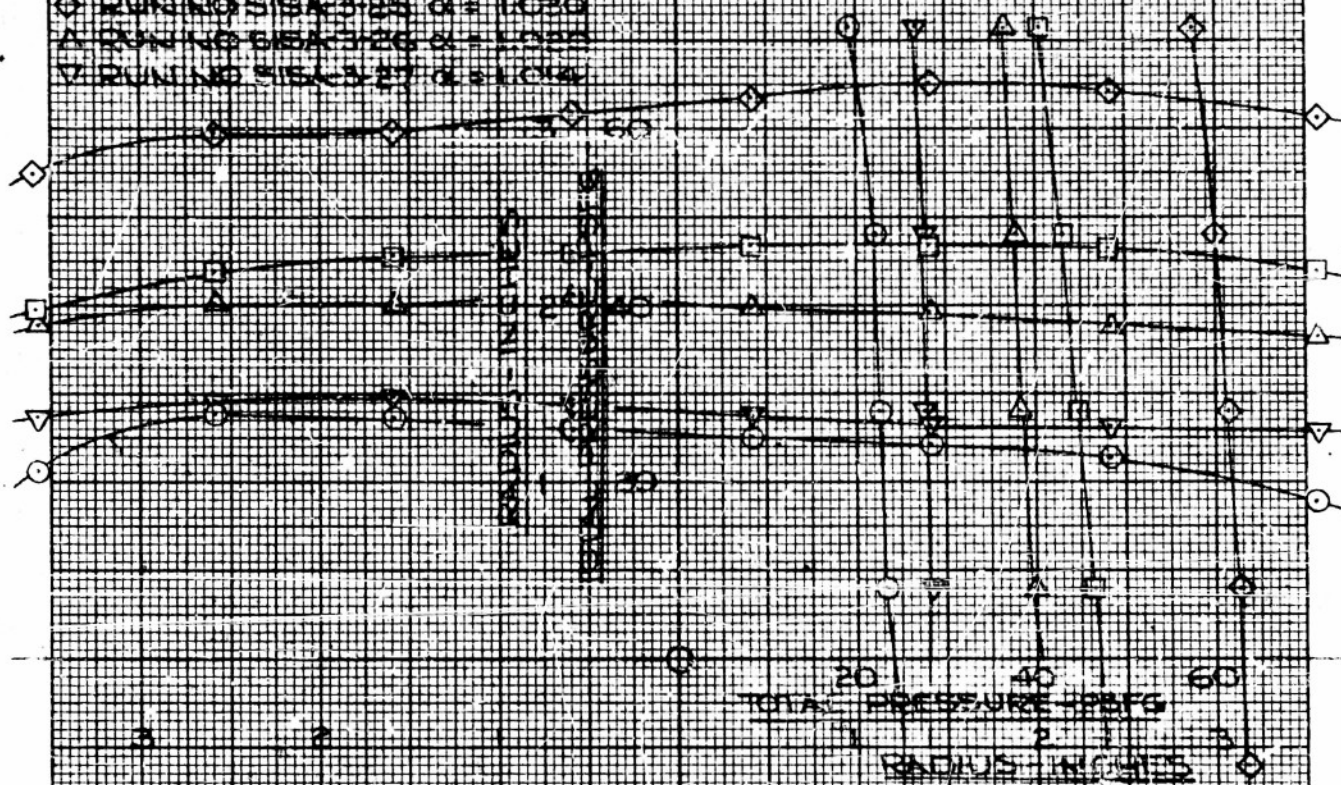
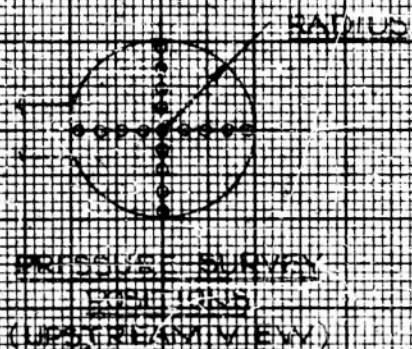
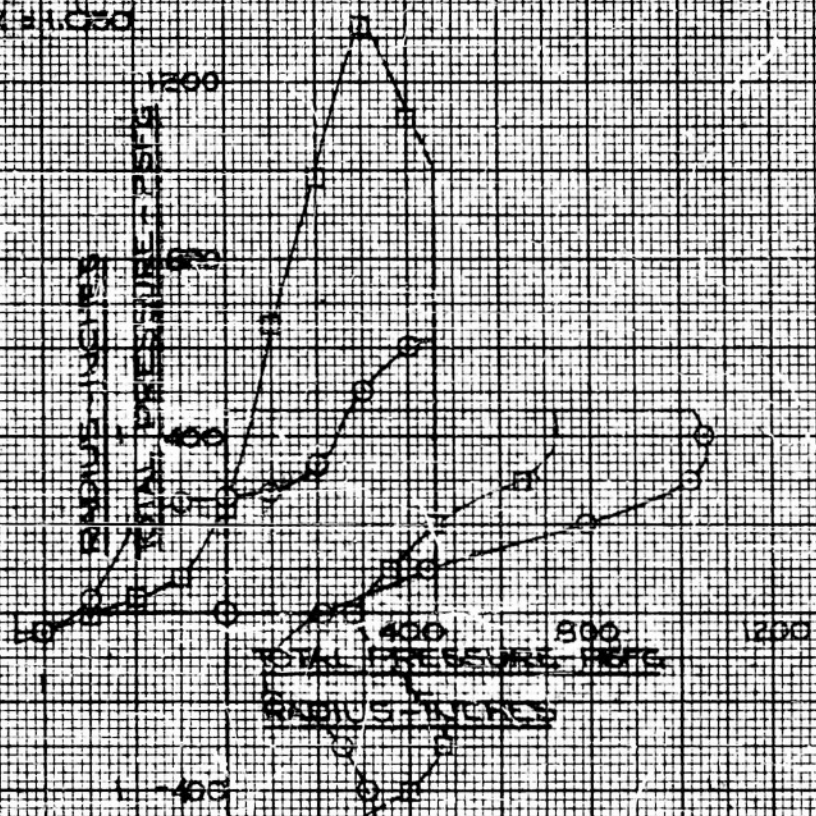


FIGURE 19 (CONT'D)



UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING  
STA A  
PRESSURE DISTRIBUTION

COPIED FROM 3-25-50  
RUN NO. 518A-3-25 R-1050



PRESSURE SURVEY  
EQUIPMENT  
(UPSTREAM VIEW)

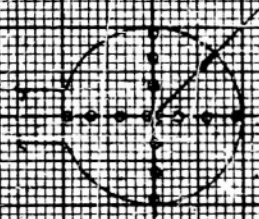
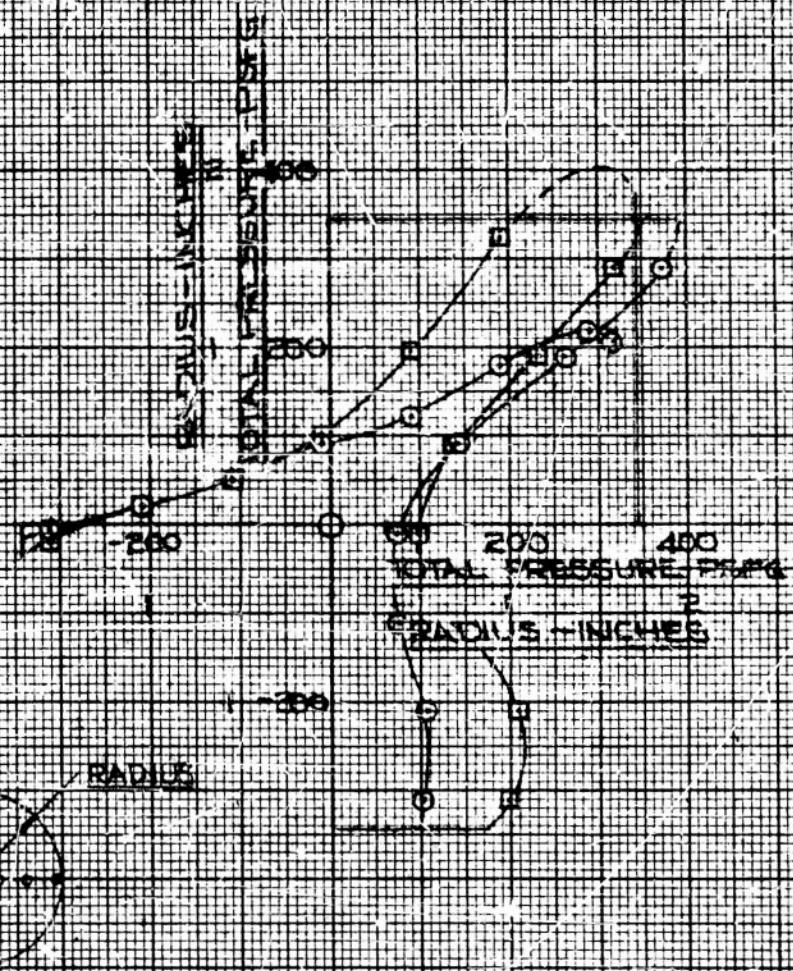
FIGURE 19 (CONT'D)

K&E  
10 X 10 TO THE 1/2 INCH  
328-11



UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING  
**STA B**  
**PRESSURE DISTRIBUTION**

1. RUN NO. 5154-23-25  $\alpha = 1.055$   
2. RUN NO. 5154-23-26  $\alpha = 1.05$



**PRESSURE SURVEY**  
**EXPLOSION**  
**(TOP VIEW)**

**FIGURE 15 (CONT'D)**

K.E.  
KENSER & KESER CO.  
10 X 10 TO THE 1/2 INCH  
320-11



UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING  
STA. C  
PRESSURE DISTRIBUTION

○ RUN NO. SISA-3-28  $\alpha = 1.0265$   
□ RUN NO. SISA-3-29  $\alpha = 1.0389$

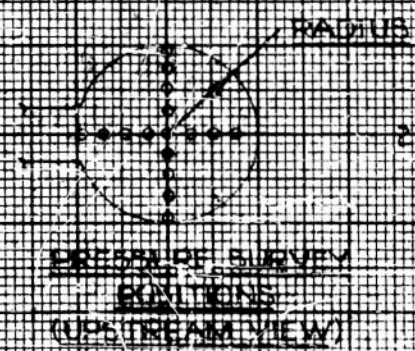
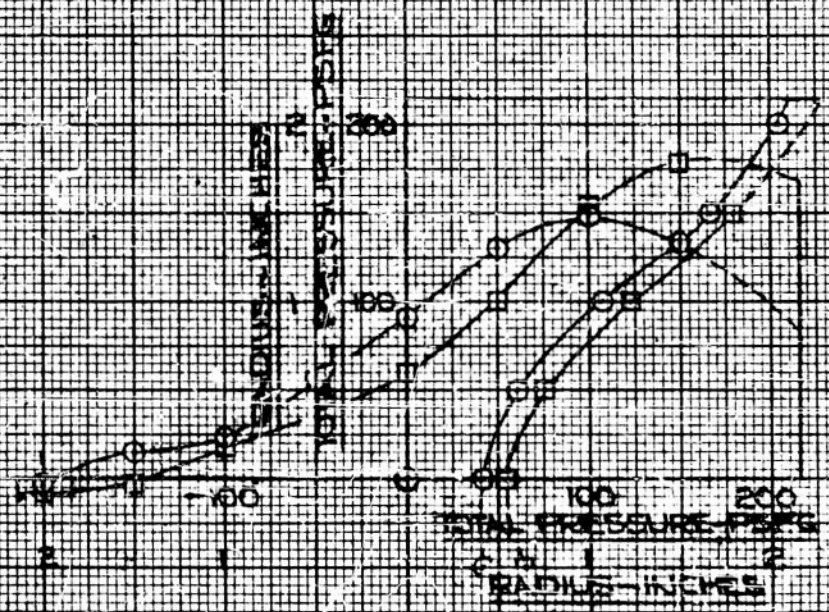


FIGURE 18 (CONT'D)

K&E  
KOLLER & EBER CO.  
10 X 10 TO THE 1/2 INCH  
320-11

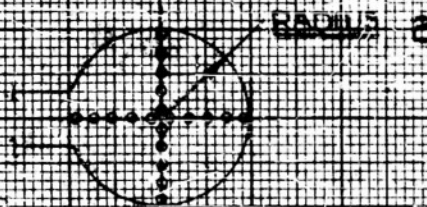
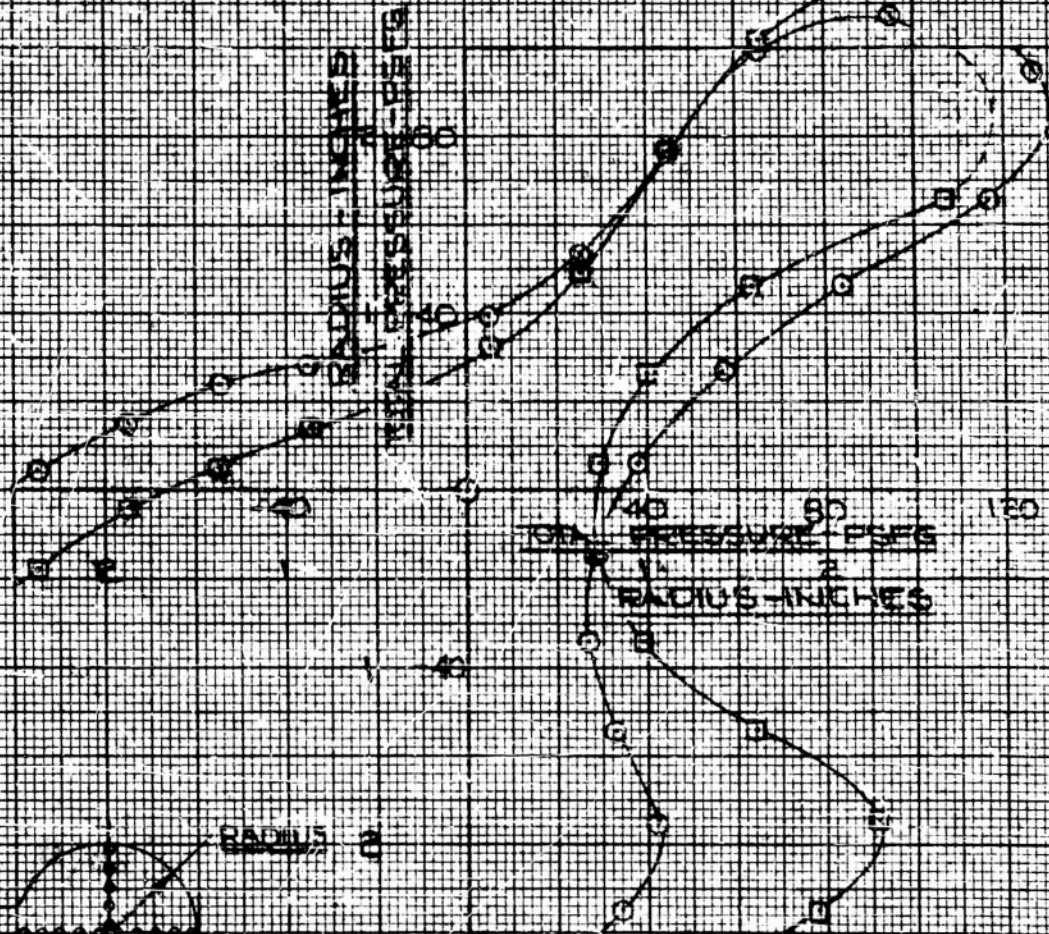


UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

STA. D

PRESSURE DISTRIBUTION

○ RADIUS NO. 515A-3-28  $\alpha = 10265$   
○ RADIUS NO. 515A-3-29  $\alpha = 1030$



PRESSURE SURVEY  
POSITION  
(UPSTREAM VIEW)

FLUE IS (CONT'D)



UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

STA E  
PRESSURE DISTRIBUTION

W. B. L. NO. 55A-3-28 Q. 10265  
E. B. L. NO. 55A-3-28 Q. 1030

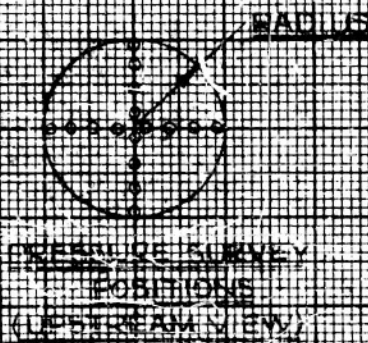
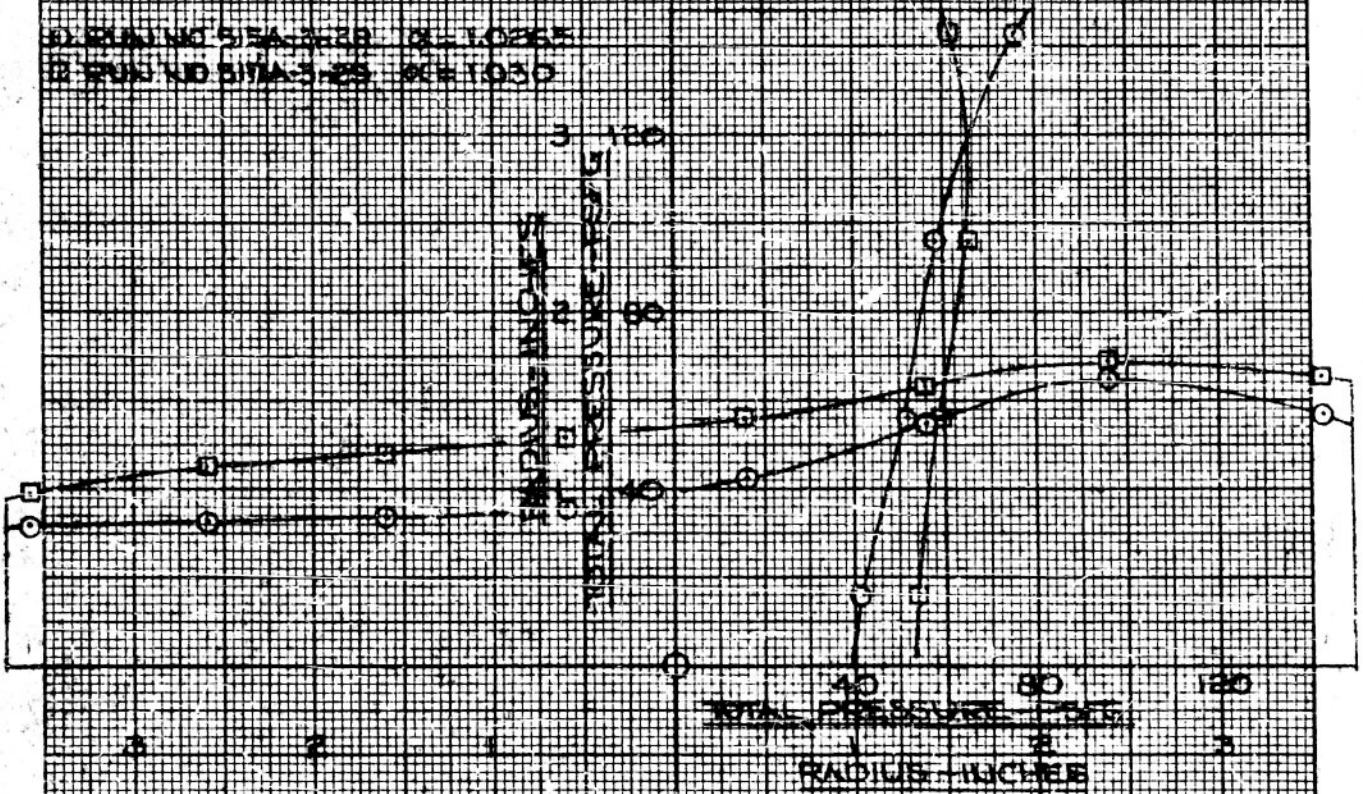


FIGURE 18 (CONT.)

K&E  
KENT & ELLIS CO.  
10 X 10 TO THE 1/2 INCH  
320-11



UNIVERSITY OF WISCONSIN  
SCHOOL OF ENGINEERING

STA F  
PRESSURE DISTRIBUTION

○ RUN NO. 518A-3-28 4-10265  
□ RUN NO. 518A-3-29 4-1030

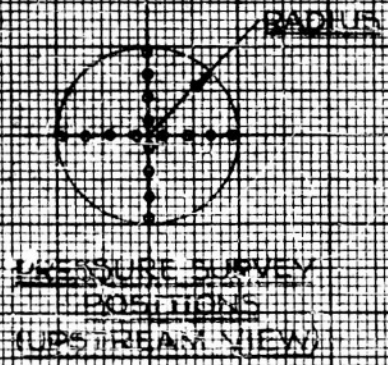
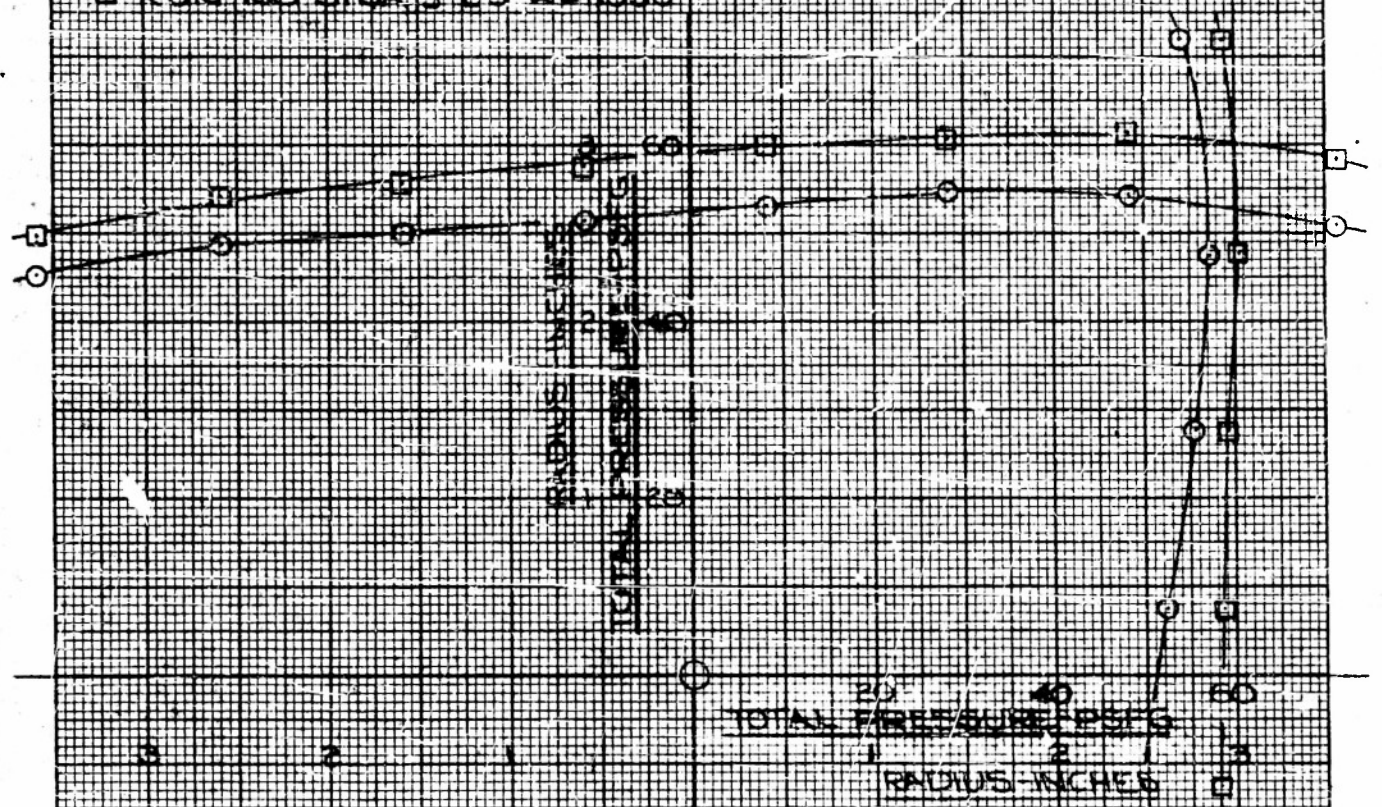


FIGURE 18 (CONCD)

W. E. KIMBLE & SONS CO.  
30 X 10 TO THE 1/2 INCH  
32-9-11

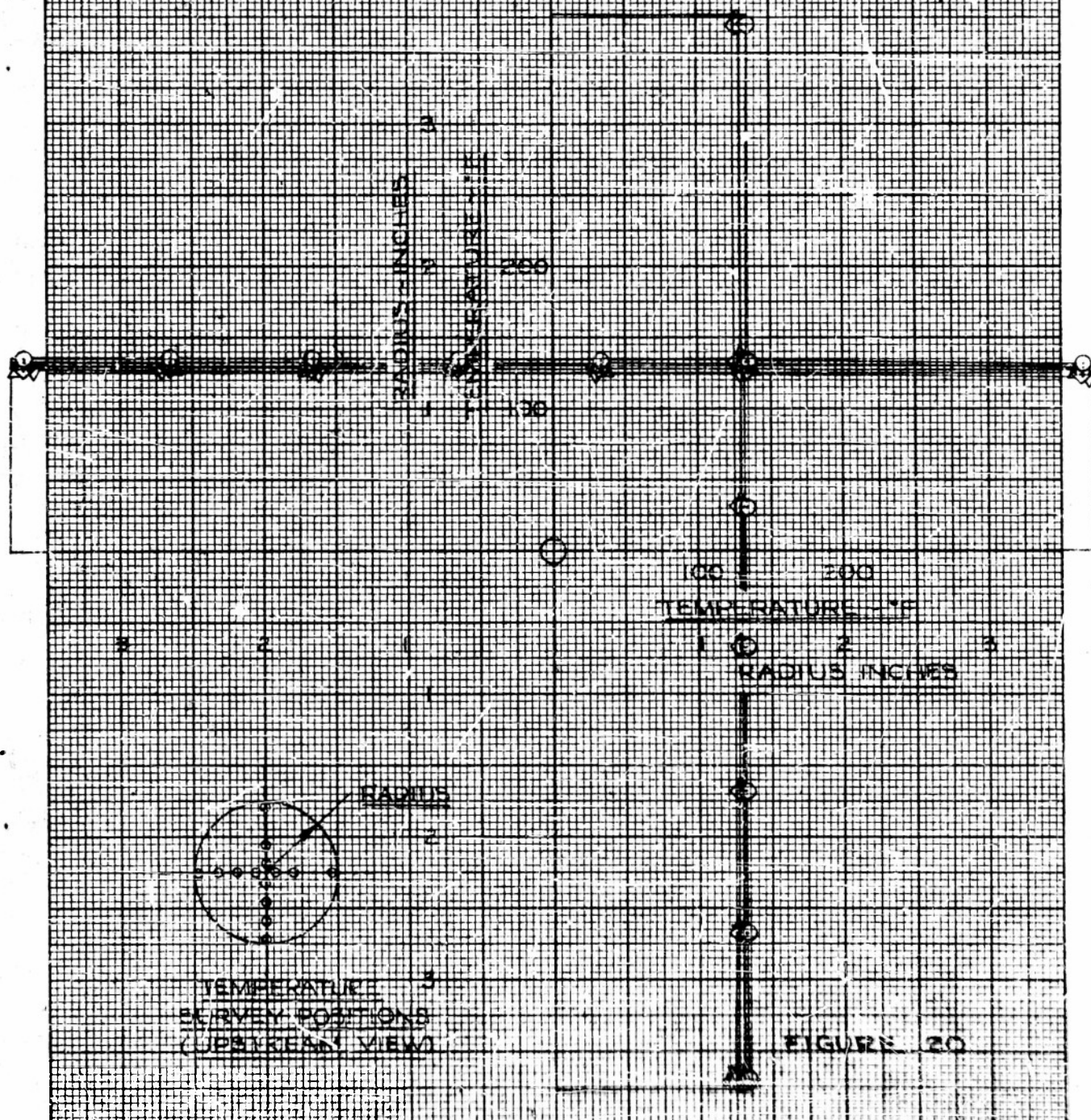


UNIVERSITY OF WISCONSIN  
SCHOOL OF ENGINEERING

STAFF

TEMPERATURE DISTRIBUTION

ORUNING SA 3-6 R. = 344.2 PSIA  
FRAMING SA 3-7 R. = 314.2 PSIA  
ORUNING SA 3-8 R. = 287.2 PSIA  
ARMING SA 3-9 R. = 262.2 PSIA  
ORUNING SA 3-10 R. = 237.2 PSIA



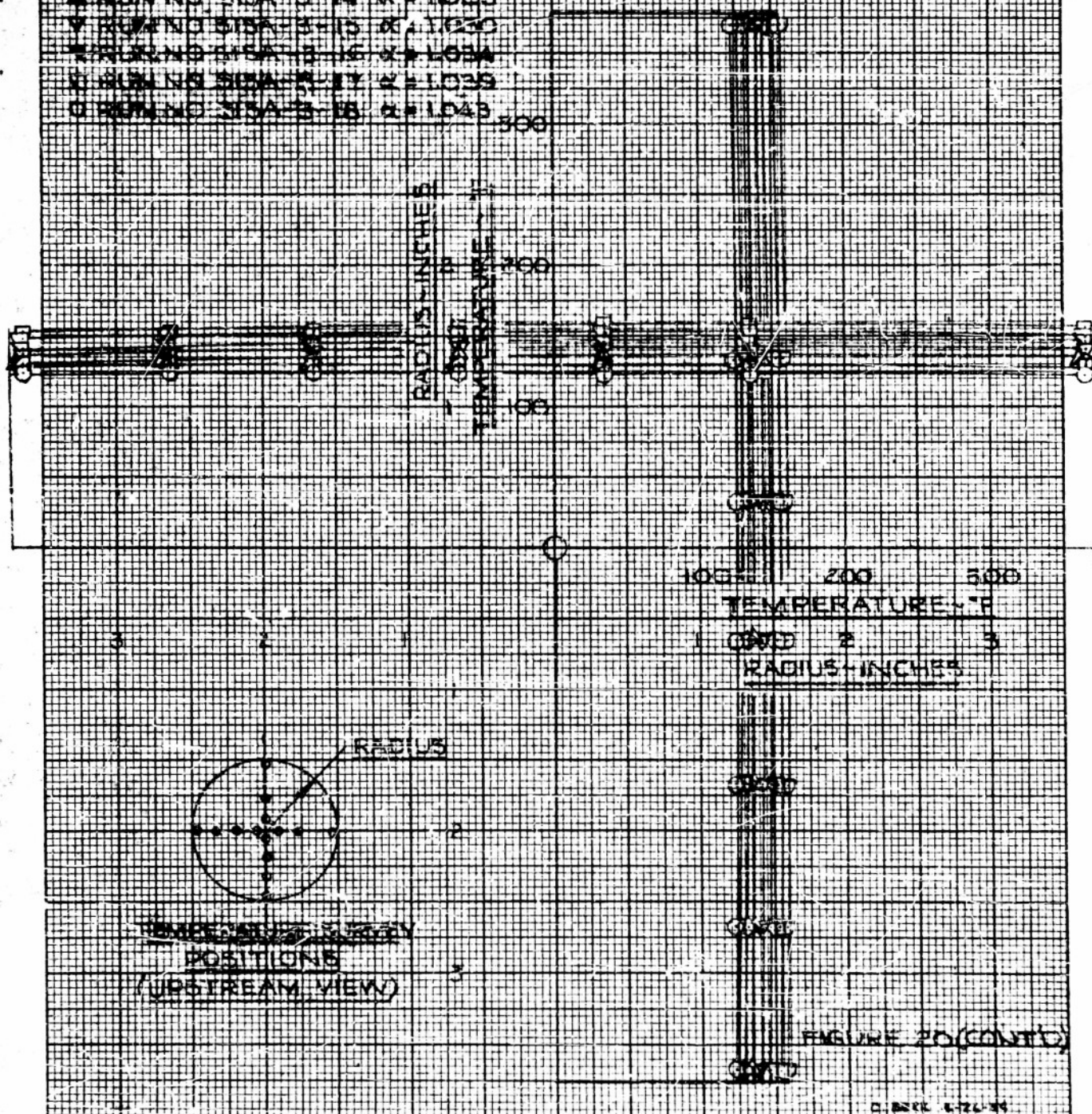


UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

STA. F

TEMPERATURE DISTRIBUTION

0. RUN NO.	515A-3-11	$\alpha = 1.013$
0. RUN NO.	515A-3-12	$\alpha = 1.017$
0. RUN NO.	515A-3-13	$\alpha = 1.021$
0. RUN NO.	515A-3-14	$\alpha = 1.025$
0. RUN NO.	515A-3-15	$\alpha = 1.030$
0. RUN NO.	515A-3-16	$\alpha = 1.034$
0. RUN NO.	515A-3-17	$\alpha = 1.038$
0. RUN NO.	515A-3-18	$\alpha = 1.043$

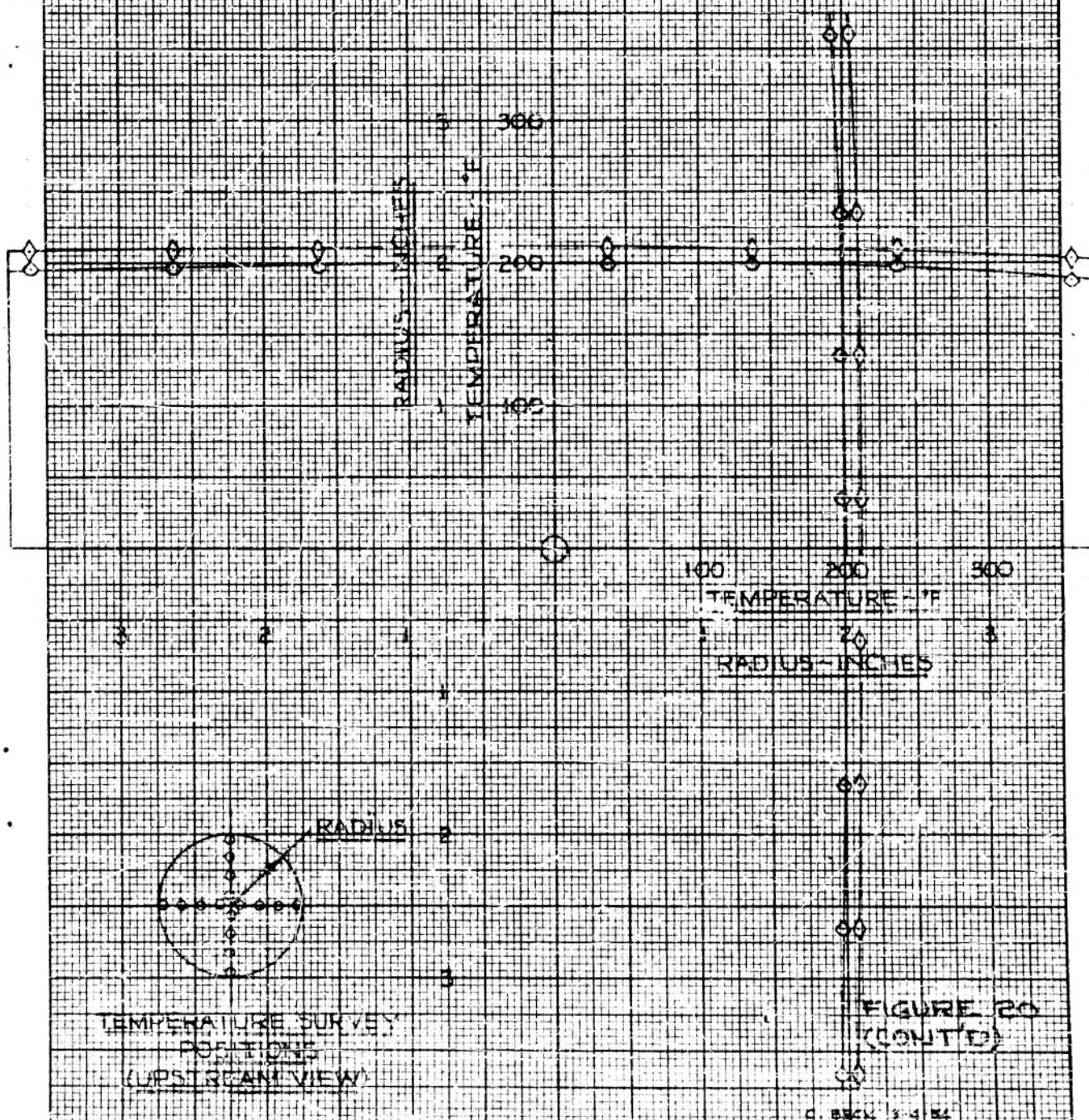




UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

STAF  
TEMPERATURE DISTRIBUTION

○ RUN NO SISA-B-19  $\alpha = 1.050$   
○ RUN NO SISA-B-20  $\alpha = 1.053$





UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

31A A

TEMPERATURE DISTRIBUTION

○ RUN NO 51EA-3-21  $\alpha = 1.0 \times 10^{-2}$

□ RUN NO 51EA-3-22  $\alpha = 1.0 \times 10^{-2}$

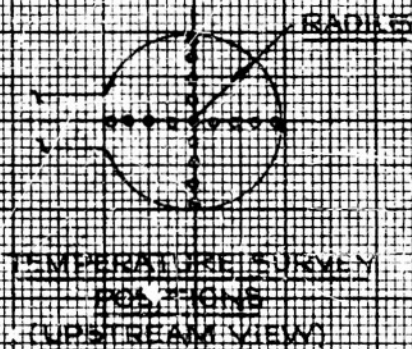
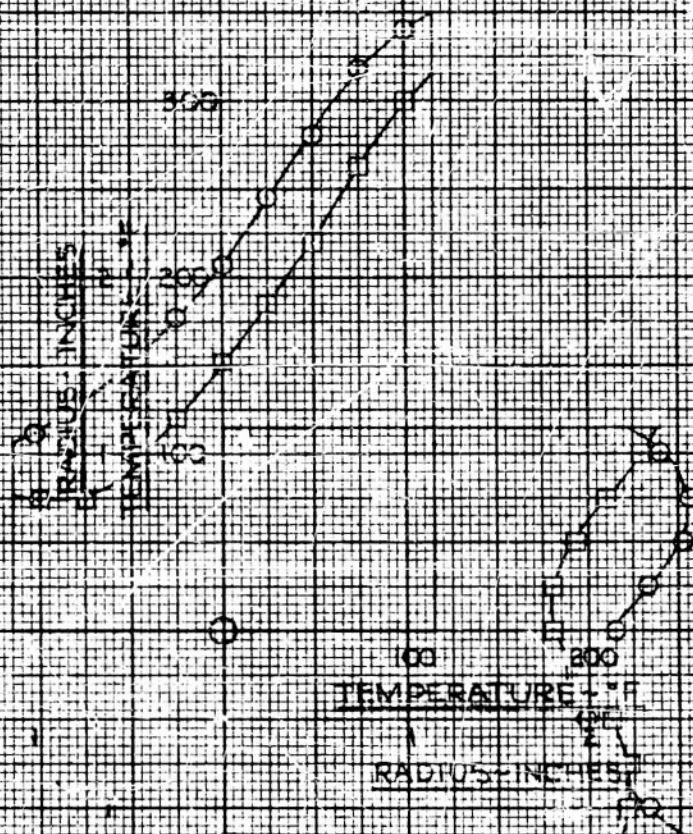


FIGURE 20 (CONT'D)

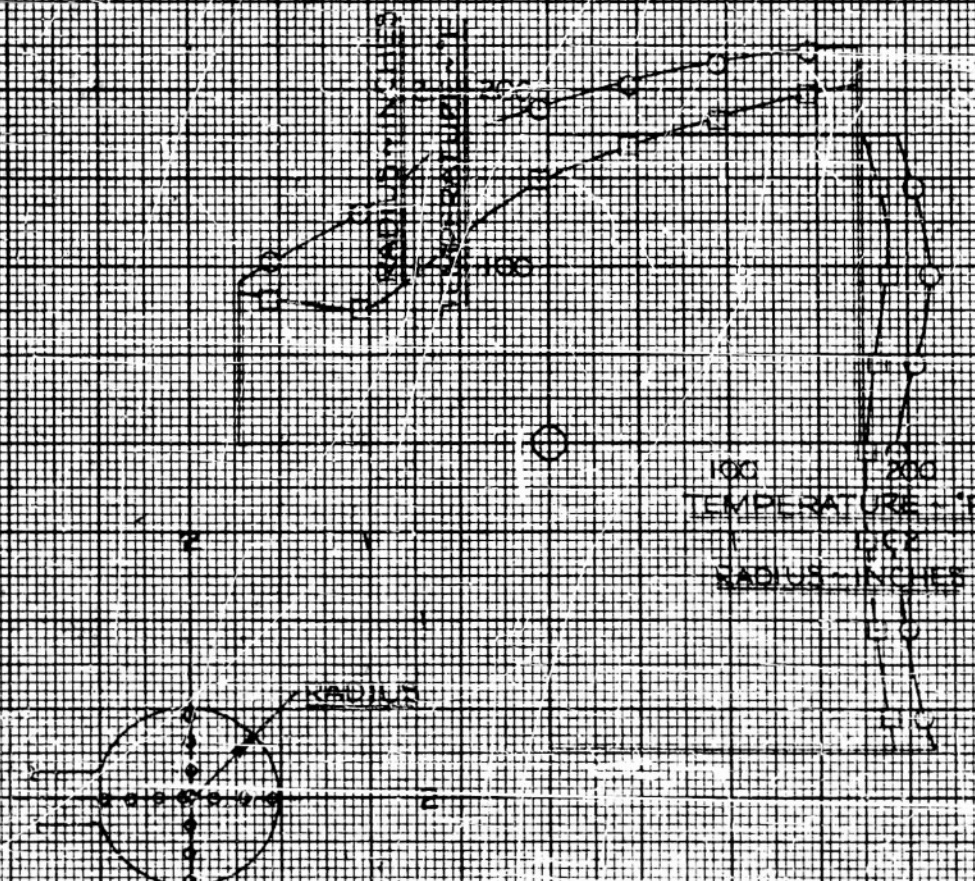
C. 2000 10-50



UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

### TEMPERATURE DISTRIBUTION

Q	3A-3-21	DATE	102
Q	3A-3-22	DATE	1040



TEMPERATURE SURVEY  
POSITIONS  
(UPSTREAM VIEW)

FIGURE 20 (CONTROL)

**K&M** KENNEL & ECCLES CO.  
10 X 10 TO THE "I" INCH 320-11 MADE IN A.S.V.

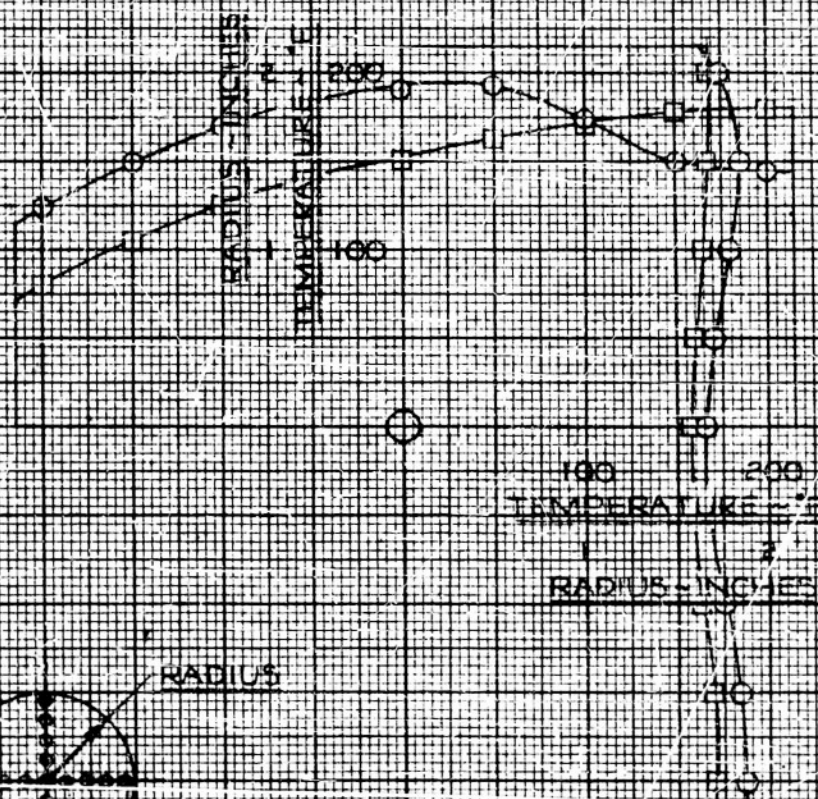


UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

STA C

TEMPERATURE DISTRIBUTION

1. RULING NO. 51543-21  $\alpha = 1.012$   
2. RULING NO. 51543-22  $\alpha = 1.040$



TEMPERATURE SURVEY  
POSITIONS  
(UPSTREAM VIEW)

FIGURE 20 (CONT'D.)

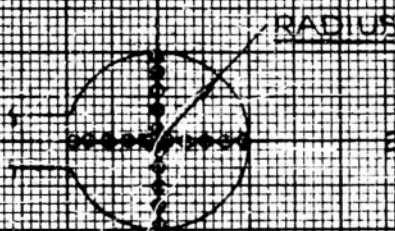
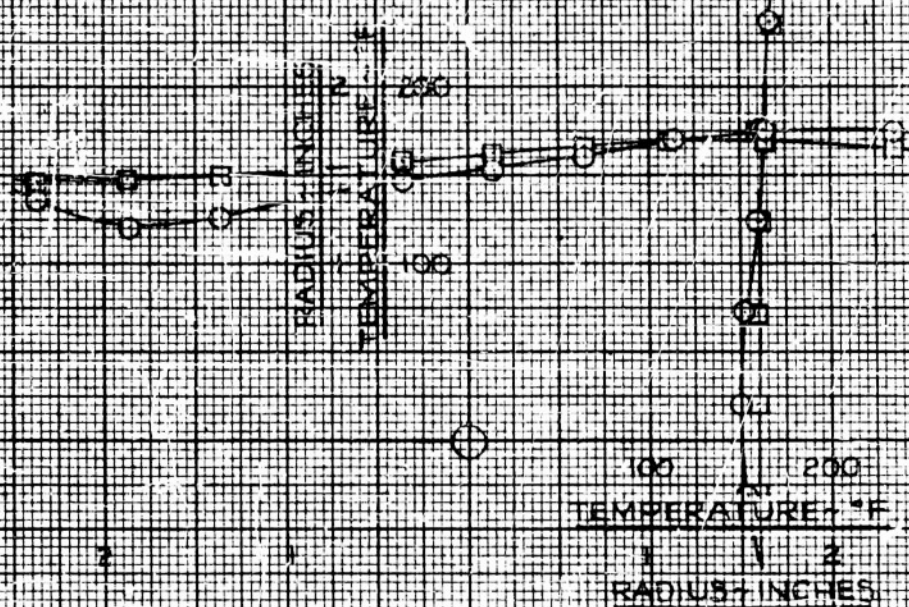


UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

STAD  
TEMPERATURE DISTRIBUTION

○ RUN NO 518A-3-21  $\alpha = 1.012$

□ RUN NO 518A-3-22  $\alpha = 1.040$



TEMPERATURE SURVEY  
POSITIONS  
(UPSTREAM VIEW)

FIGURE 20 (CONT'D)

U. WICHITA 8-27-68

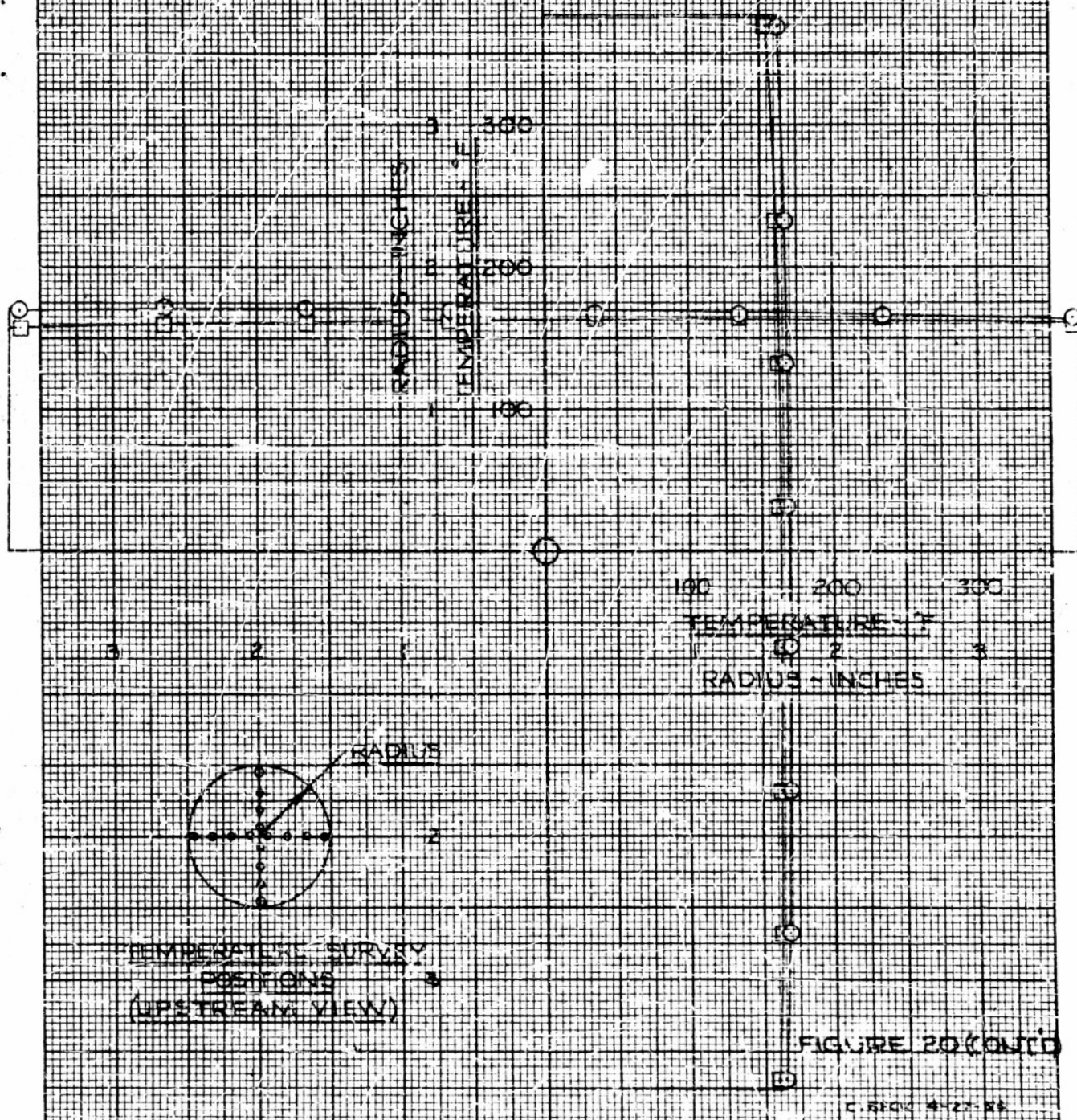


UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

STA E

TEMPERATURE DISTRIBUTION

BRUNN NO. 515A-4-21  $\alpha = 1.012$   
BRUNN NO. 515A-5-22  $\alpha = 1.040$



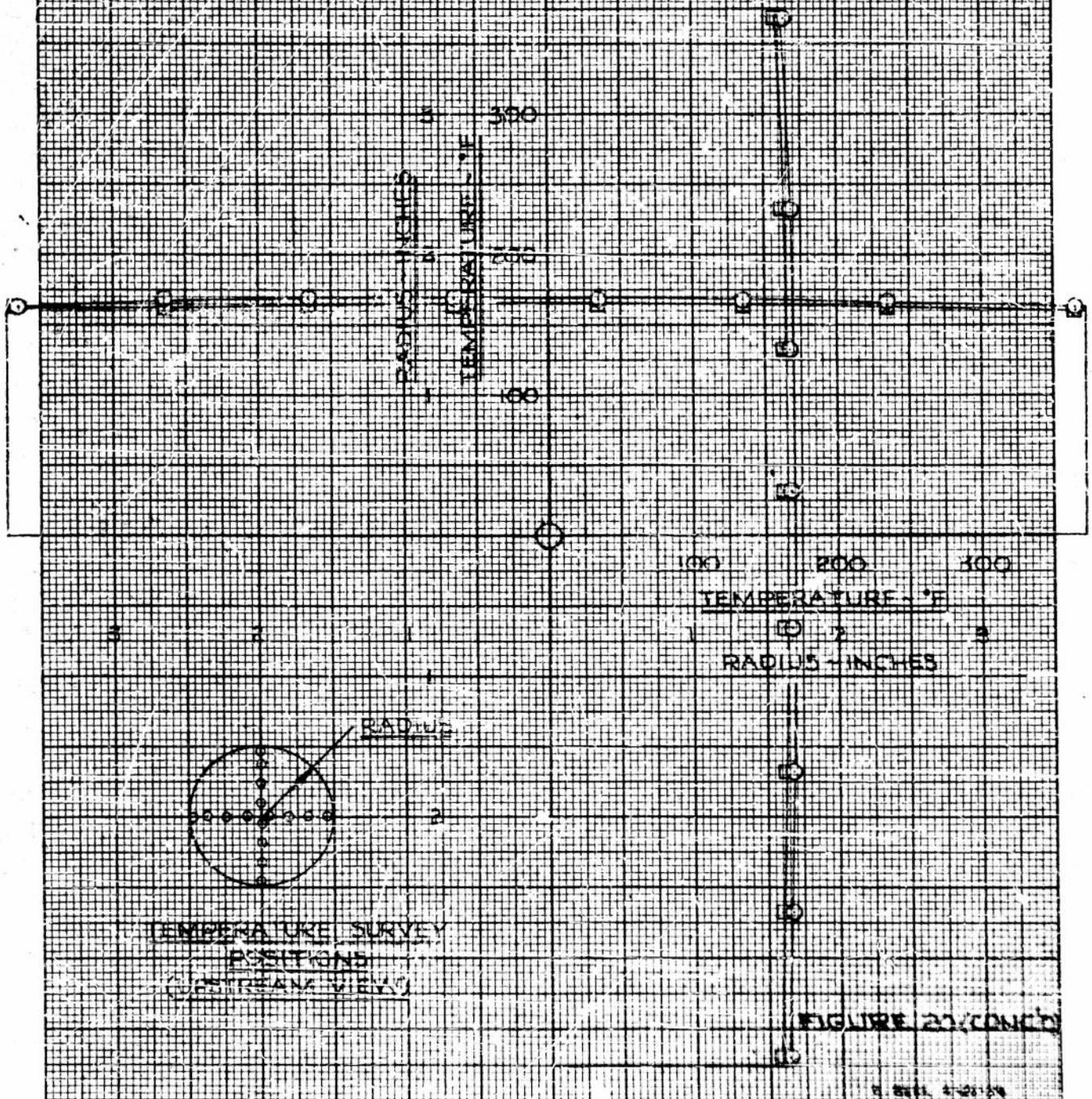


UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

STA 5

TEMPERATURE DISTRIBUTION

WICHITA RIVER GA. NO. 1012  
RUN NO. 315A-8-25 QLE 1.040



K&E KENNEL & EGGERS CO.  
10 X 10 10 JOINTS 15 INCH

8111 11-27-71  
329-11



UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

SISA F

## TEMPERATURE DISTRIBUTION

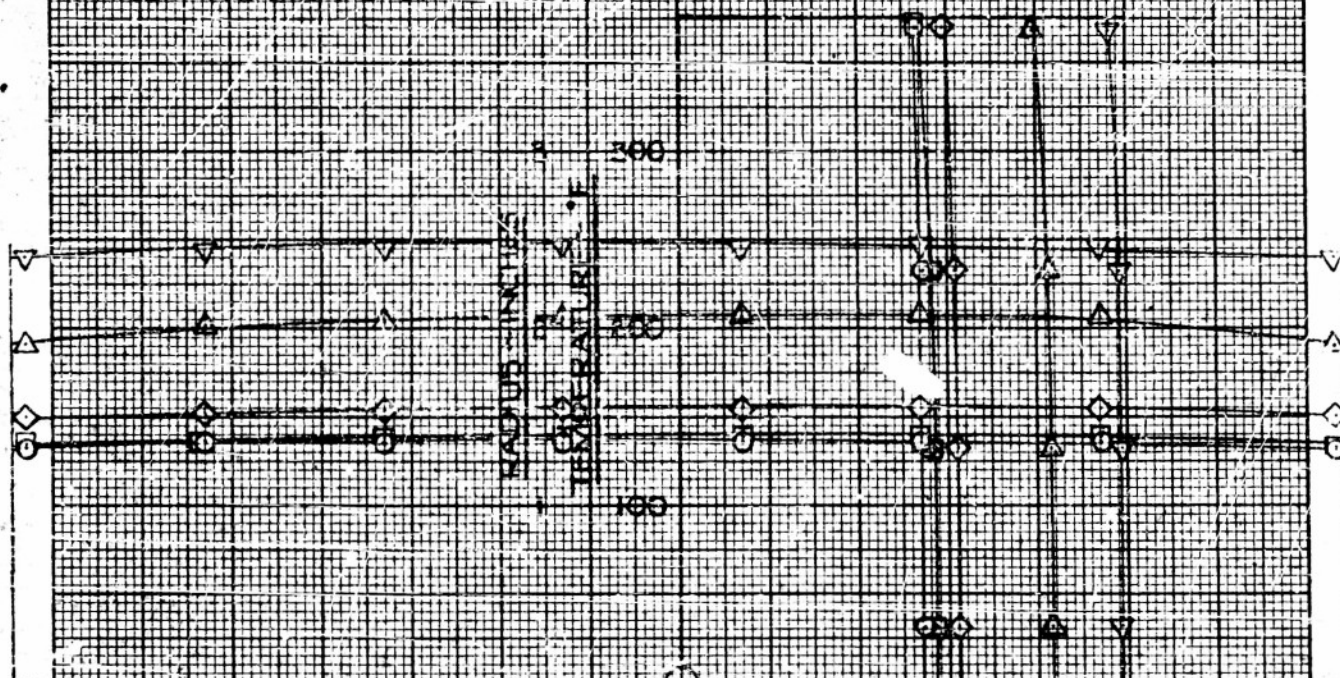
O RUN NO SISA-B-23 Q=1.070

B RUN NO SISA-B-24 Q=1.522

D RUN NO SISA-B-25 Q=1.030

A RUN NO SISA-B-26 Q=1.020

V RUN NO SISA-B-27 Q=1.074



TEMPERATURE - F

RADIUS - INCHES

TEMPERATURE SURVEY

POSITION

(UPSTREAM VIEW)

FIGURE 26  
(CONT'D)

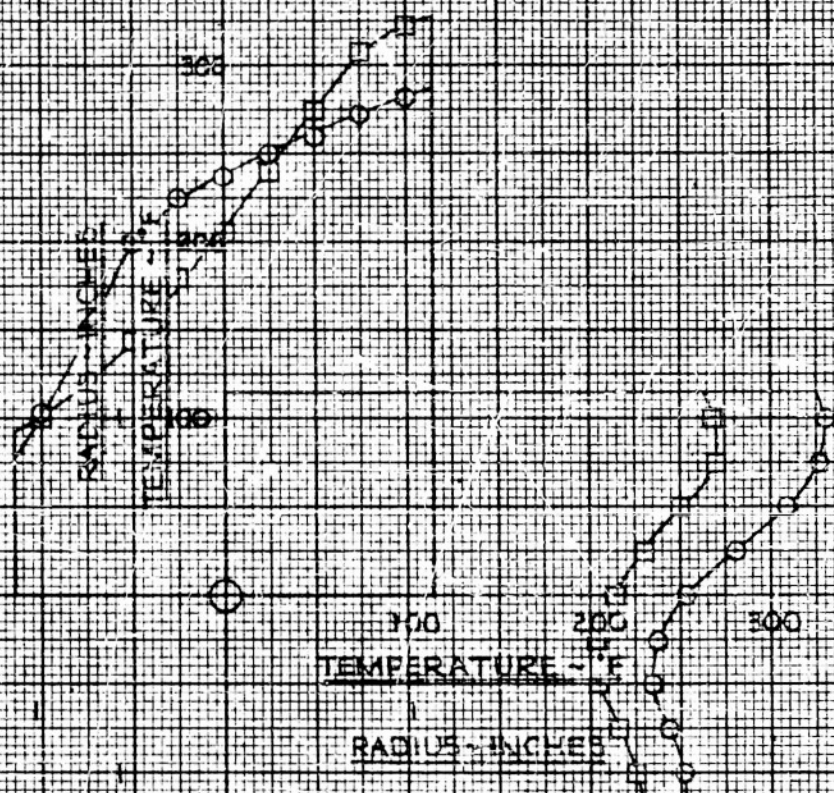
C. DECK, 11/18/54



UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING  
STA A  
TEMPERATURE DISTRIBUTION

CRUNNO SISA-3-28 Q# 10265

CRUNNO SISA-3-28 Q# 10300



TEMPERATURE SURVEY  
POSITIONS  
(UPSTREAM VIEW)

FIGURE 20 (CONT'D)



UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

STATION

TEMPERATURE DISTRIBUTION

0. RUN NO. 515A-13-28  $\alpha = 1.0265$

1. RUN NO. 515A-14-25  $\alpha = 1.030$

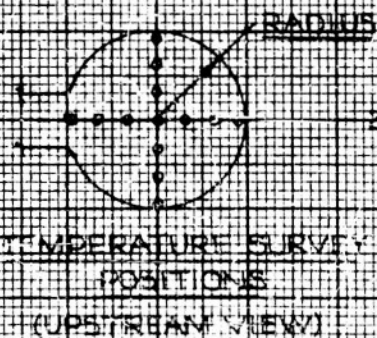
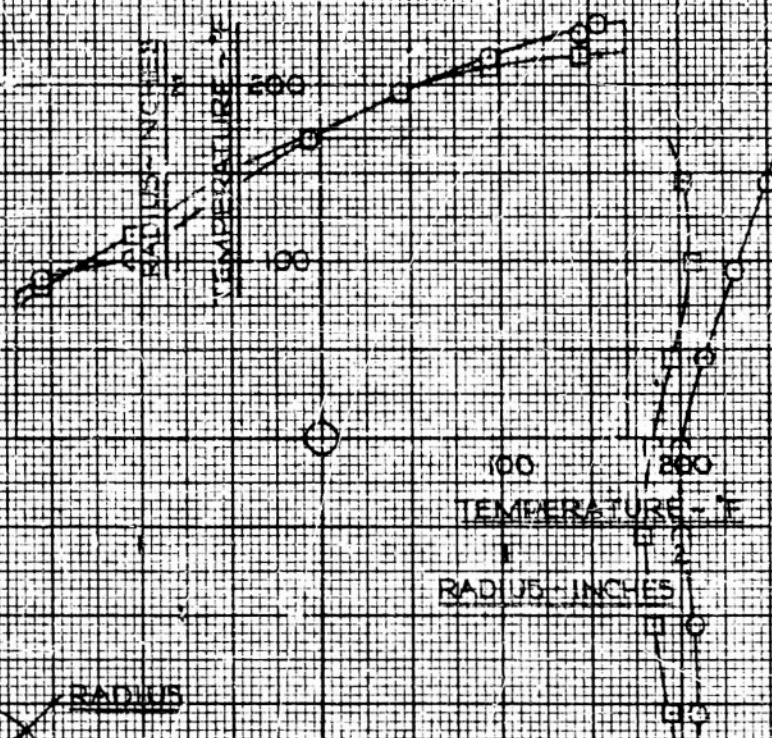


FIGURE 20 (CONT'D)

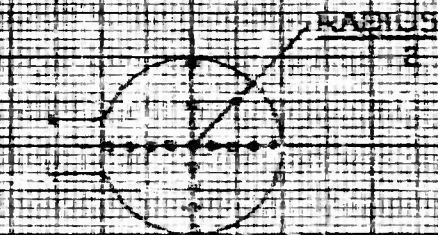
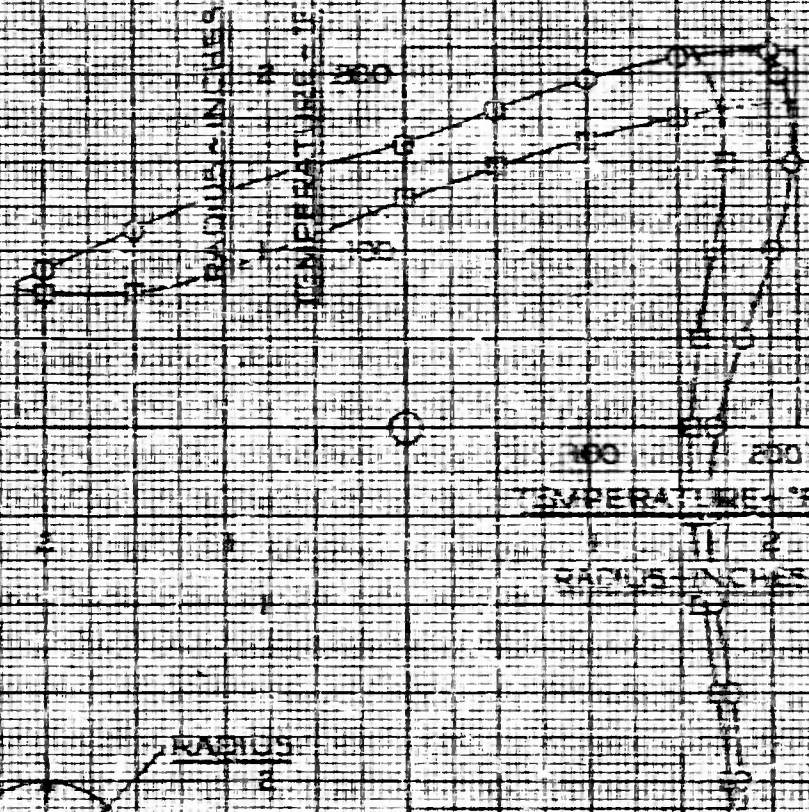
UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING

ETAC

TEMPERATURE DISTRIBUTION

GRUNING SISA-3-28-4-10265

GRUNING SISA-3-29-4-10265



TEMPERATURE SURVEY  
POSITIONS  
(UPSTREAM VIEW)

FIGURE 20 (CONT'D)

C. H. C. 3-50-65



UNIVERSITY OF WICHITA  
SCHOOL OF ENGINEERING  
STAD  
TEMPERATURE DISTRIBUTION

0 RUN NO. 514-5-28 X-10265  
10 RUN NO. 514-5-28 X-10265

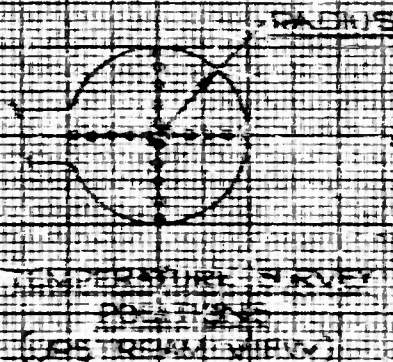
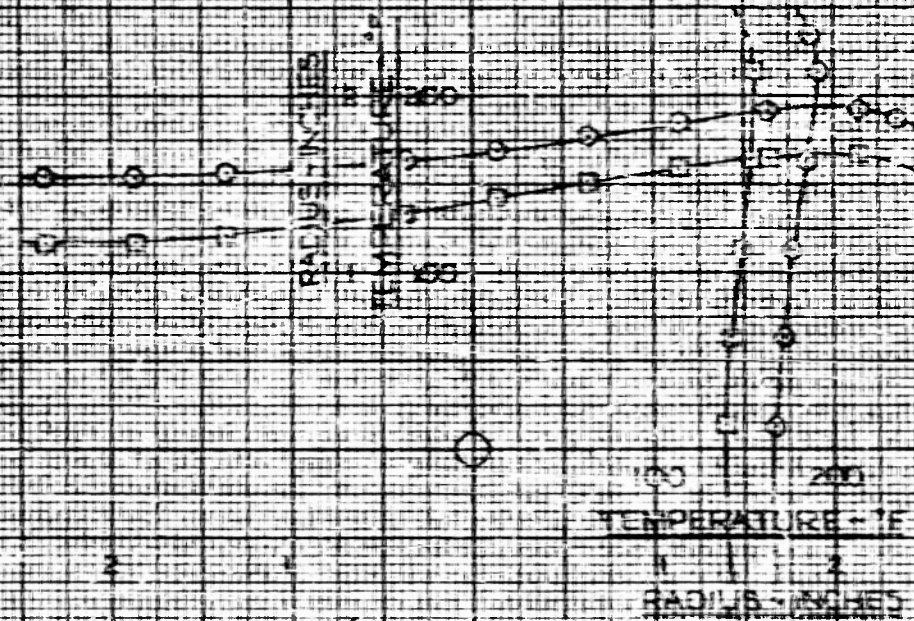


FIGURE 20 (CONT'D)

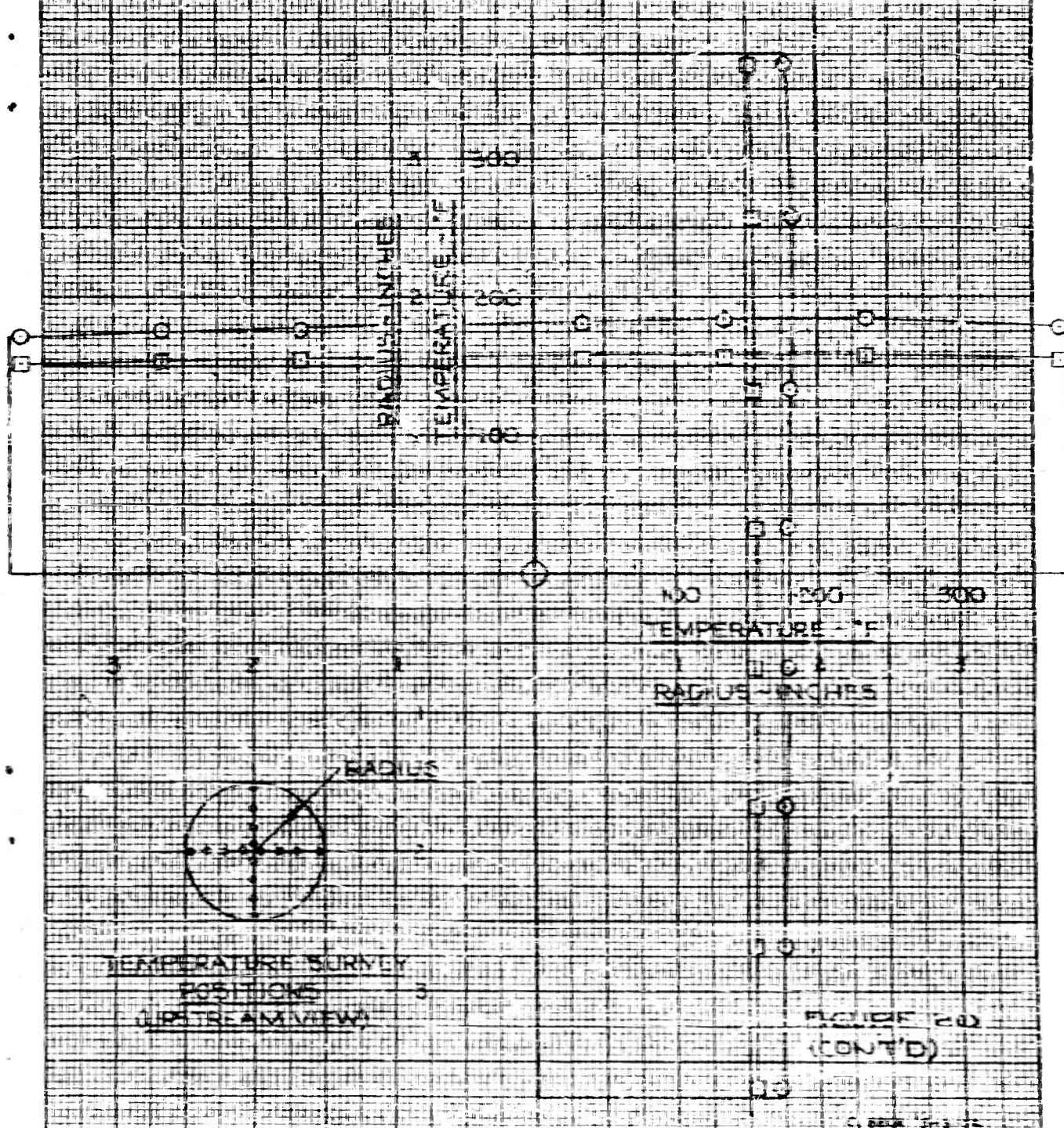
UNIVERSITY OF MICHIGAN  
SCHOOL OF ENGINEERING

## STA E

## TEMPERATURE DISTRIBUTION

PIPE NO. BISA-3-28  $\alpha = 0.0265$

PIPE NO. BISA-3-29  $\alpha = 0.0330$



K&E  
10 X 10 LO ANE IN INCH  
22071



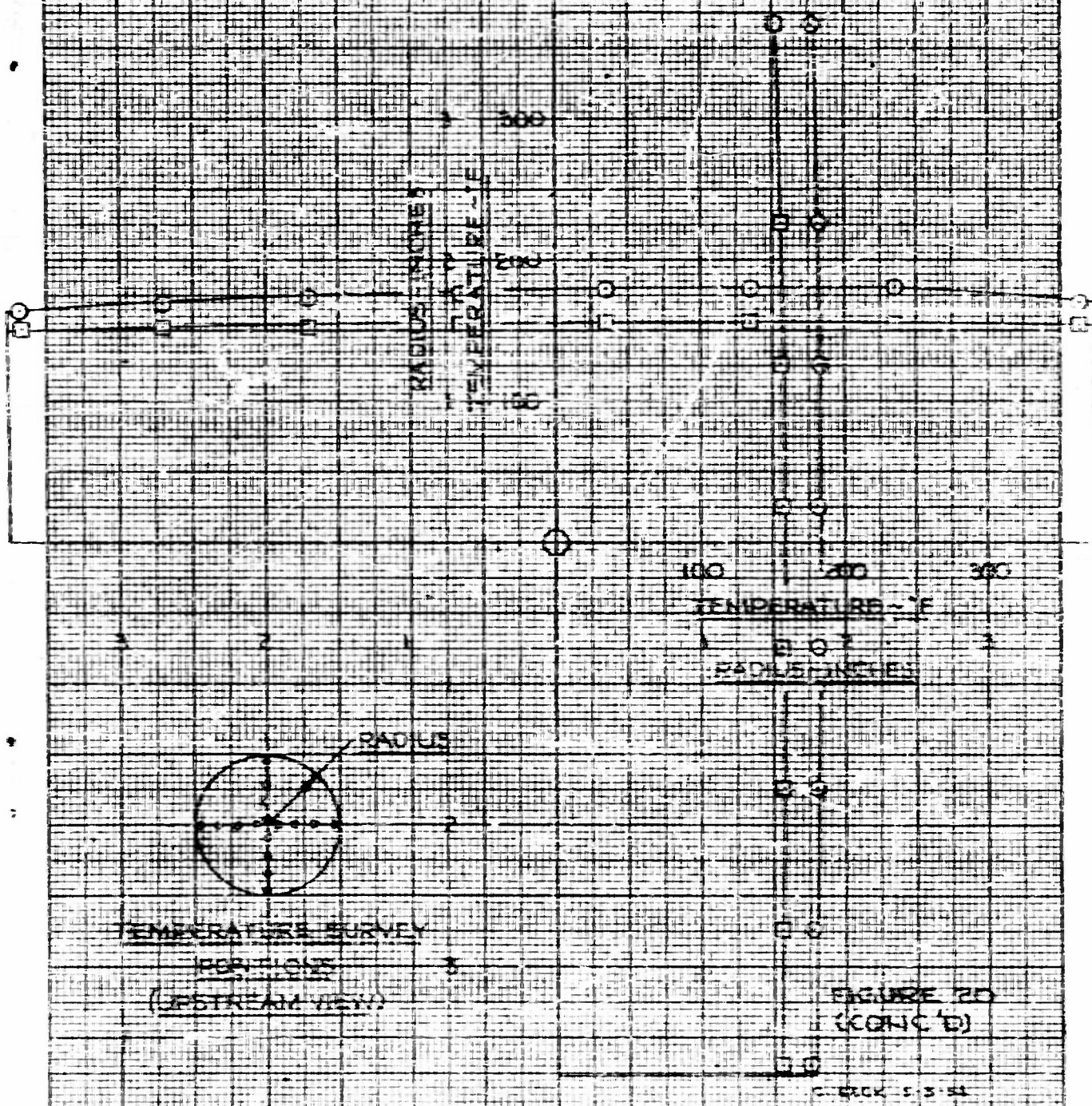
UNIVERSITY OF WISCONSIN  
SCHOOL OF ENGINEERING

STAFF

TEMPERATURE DISTRIBUTION

0 RUN NO SISA 3-78  $\alpha = 1.0285$

11 RUN NO SISA 3-78  $\alpha = 1.0300$



11-882  
KODAK SAFETY FILM  
10 X 10 INCHES  
10 X 10 INCHES  
10 X 10 INCHES

UNIVERSITY OF WISCONSIN, SCHOOL OF ENGINEERING  
PERFORMANCE TEST OF A SIDE-INLET, STEADY-AIR-JET  
PUMP WITH AN INBOARD NOZZLE AND A TAPERED MIXING TUBE  
A.M. Beinrich. May 1954. 76 pp., diagrs., photos.,  
2 refs.

the effects of varying the primary jet pressure, the pump pressure ratio, and the cascades were determined. Pump pressure ratio was varied both with and without control of the suction-slot flow distribution. Flow direction in the suction duct between the slot and the throat was studied with the aid of wool tufts.

UNWEA No. 138

University of Wichita, School of Engineering  
PERFORMANCE TEST OF A SIDE-INLET, STEAM-TO-AIR JET  
PUMP WITH AN INNOVATIVE NOZZLE AND A TAPERED MIXING TUBE  
A. H. Heinrich. May 1954. 76 pp., diagrams, photos.,  
2 refs.

The effects of varying the primary jet pressure, the pump pressure ratio, and the cascades were determined. Pump pressure ratio was varied both with and without control of the suction-axial flow distribution. Flow direction in the suction duct between the exit and the throat was studied with the aid of wool tufts.

performance curves are presented together with curves showing mixing-tube, cross-sectional distributions of temperature and total pressure taken at several survey stations. This report is the second in a series on slue-inlet jet pumps with different taper ratio mixing tubes.

1.- Aerodynamion.  
Viscous flow  
2.- Jet Pump  
I.- Helrich, A.M.  
IT.- OTHER No. 138

the effects of varying the primary jet pressure, the pump pressure ratio, and the cascades were determined. Pump pressure ratio was varied both with and without control of the suction-slot flow distribution. Flow direction in the suction duct between the slot and the throat was studied with the aid of wool tufts.

**DWTS No. 118**

- 1.- Aerodynamics,  
Viscous Flow
- 2.- Jet Pumps
- I.- Heinrich, A.M.
- II.- THREE No. 138

The effects of varying the primary jet pressure, the pump pressure ratio, and the cascades were determined. Pump pressure ratio was varied both with and without control of the suction-axial flow distribution. Flow direction in the suction duct between the exit and the throat was studied with the aid of wool tufts.

performance curves are presented together with curves showing mixing-tube, cross-sectional distributions of temperature and total pressure taken at several survey stations. This report is the second in a series on slue-inlet jet pumps with different taper ratio mixing tubes.

ORDER No. 138

University of Wichita, School of Engineering  
PERFORMANCE TEST OF A SIDE-INLET, STEAM-TO-AIR JET  
WITH AN INBOARD NOZZLE AND A TAPERED MIXING TUBE  
42-N. Heinrich. May 1954. 76 pp., diagrs., photos.,  
2 refs.

The effects of varying the primary jet pressure, the pump pressure ratio, and the cascade were determined. The pump pressure ratio was varied both with and without control of the suction-slot flow distribution. Flow distribution in the suction duct between the slot and the throat was studied with the aid of wool tufts.

performance curves are presented together with curves showing mixing-tubs, cross-sectional distributions of temperature and total pressure taken at several survey stations. This report is the second in a series on side-inlet jet pumps with different taper ratio mixing-tubes.

**DWTS No. 118**

University of Wichita, School of Engineering.  
PERFORMANCE TEST OF A SIDE-INLET, STEAM-TO-AIR JET  
PUMP WITH AN INBOARD NOZZLE AND A TAPERED MIXING TUBE  
A.M. Heierlich. May 1954. 76 pp., diagrams, photos.,  
2 refs.

The effects of varying the primary jet pressure, the pump pressure ratio, and the cascades were determined. Pump pressure ratio was varied both with and without control of the suction-slot flow distribution. Flow direction in the suction duct between the slot and the throat was studied with the aid of wool tufts.

Performance curves are presented together with curves showing mixing-tube, cross-sectional distributions of temperature and total pressure taken at several survey stations. This report is the second in a series on side-inlet jet pumps with different taper ratio mixing tubes.

1.- Aerodynamic,  
Viscous Flow  
2.- Jet Pump  
I.- Heirrich, A.M.  
II.- UWER No. 138

1.- Aerodynamics,  
Viscous Flow  
2.- Jet Pumps  
I.- Heinrich, A.M.  
II.- USTER No. 138



# Armed Services Technical Information

Because of our limited supply, you are requested to return this copy WHEN IT HAS SERVED YOUR PURPOSE so that it may be made available to other requesters. Your cooperation will be appreciated.

# AD

# 41734

NOTICE: WHEN GOVERNMENT OR OTHER DRAWINGS, SPECIFICATIONS OR OTHER DATA ARE USED FOR ANY PURPOSE OTHER THAN IN CONNECTION WITH A DEFINITELY RELATED GOVERNMENT PROCUREMENT OPERATION, THE U. S. GOVERNMENT THEREBY INCURS NO RESPONSIBILITY, NOR ANY OBLIGATION WHATSOEVER; AND THE FACT THAT THE GOVERNMENT MAY HAVE FORMULATED, FURNISHED, OR IN ANY WAY SUPPLIED THE SAID DRAWINGS, SPECIFICATIONS, OR OTHER DATA IS NOT TO BE REGARDED BY IMPLICATION OR OTHERWISE AS IN ANY MANNER LICENSING THE HOLDER OR ANY PERSON OR CORPORATION, OR CONVEYING ANY RIGHTS OR PERMISSION TO MANUFACTURE OR USE OR SELL ANY PATENTED INVENTION THAT MAY IN ANY WAY BE RELATED THEREIN.

Reproduced by  
**DOCUMENT SERVICE CENTER**  
KNOTT BUILDING, DAYTON, 2, OHIO

# UNCLASSIFIED